

# **INTERMEDIATE (IPC) COURSE**

## **STUDY MATERIAL**

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**PAPER : 7A**

# **INFORMATION TECHNOLOGY**



**BOARD OF STUDIES**  
**THE INSTITUTE OF CHARTERED ACCOUNTANTS OF INDIA**

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## A WORD ABOUT STUDY MATERIAL

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The emergence of Information Technology (IT) has very significant impact on all activities related to Accounting Profession. An accountant who does not comprehend computer-based accounting system is likely to be left high and dry in the profession. Recognizing the importance of IT, Chartered Accountancy course has included it as a part of the course curriculum both at Intermediate (IPC) and Final levels. A paper on 'Information Technology' forming the part of curriculum at Intermediate (IPC) level of the Chartered Accountancy course is to provide the understanding of the fundamental concepts of how Business Process Management and Information Systems are closely interfaced with IT to provide the required Business Process Automation for enterprises.

In this prompt shifting world of Information and Communication Technologies, the Institute felt an urgent need to revisit the syllabus of IT related papers separately and hence, the syllabus of 'Information Technology' paper has been revised with a view to rationalize the same in the light of recent technological developments by making necessary additions/deletions and modifications therein.

This paper enables students to understand how business processes are automated and explains the business implications, considerations and imperatives for practical deployment of IT in enterprises. The topics covered are closely linked with the topics covered in other papers viz. "Strategic Management" and "Audit and Assurance", which will facilitate students to understand the conceptual framework of business processes and information systems and thus assist better understanding of topics covered in the curriculum. The topics covered in this paper elucidate how business processes and information systems are inter-linked and how these can be automated using different IT components.

Students may note that the CA course is not just about understanding of theory but provides a platform for practical application of the knowledge gained, through their work as articles in the area of compliance, assurance or advisory services. The study material covered both concepts and practical aspects and hence, students are advised to read the study material not only from examination point of view but also from practical perspective of how this is relevant and can be applied to their work environment.

The overall learning objective of this paper ***"To develop understanding of Information technology as a key enabler and facilitator of implementing Information systems in enterprises and their impact on business processes and controls"*** has been kept in mind while developing the material. The learning objectives are translated into a set of task statements, which outline what the students should learn "to do". The task statements are linked to a set of knowledge statements, which outline what they should "know" to be able to perform the tasks. All these together have been used to develop the topics, which provide the detailed contents with a logical flow. Chapter-wise coverage of various topics in the study material is given as follows:

**Chapter 1** introduces the concept of Business Process Management (BPM) and Business Process Re-Engineering (BPR) in bringing about integration and significant improvement in business processes. Impact of IT on business processes, its risks and benefits are also discussed in this chapter. Further, it provides an insight to the different mapping systems like Entity Diagrams, DFDs, Decision Trees and some more.

**Chapter 2** includes the discussion on the relevance of auditing in Business Processes, the phases of System Development Life Cycle (SDLC) and overview of Information Systems layers. Overview of latest technological devices and popular computing models and architectures are also focused here.

**Chapter 3** deals with the topics on fundamentals, components and functioning of Telecommunication systems, different types of networks and their architectures. Afterwards, the chapter provides an insight on the working of internet and its different technologies.

**Chapter 4** comprehensively converses in detail various types of Business Information Systems at different levels of an organization. Further, the students are also introduced with some specialized systems like Core Banking system, CRM, ERP, CBS etc. used world wide. Business reporting through IT and organization roles and importance of access controls are outlined in this chapter for the sake of clarity of students of the concept.

**Chapter 5** highlights various aspects pertaining to business process automation through application software. Emerging concepts in the field of IT like virtualization, Grid computing, cloud delivery model etc. are also covered in this chapter.

The significant additions in the revised edition are highlighted in **Bold** and *Italics* and have also been consolidated in the form of table “Significant Additions in the Revised Edition” in subsequent page.

In case you need any further clarification/guidance, please send your queries at [bosnoida@icai.in](mailto:bosnoida@icai.in)/ [sukriti.arora@icai.in](mailto:sukriti.arora@icai.in).

## SIGNIFICANT ADDITIONS/MODIFICATIONS IN 2015 EDITION OVER 2014 EDITION

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Chapter no.	Chapter name	Sections/ sub sections wherein major additions/updatations have been done	Page numbers
2	Information Systems and IT Fundamentals	Re-ordering	2.30
5	Business Process Automation through Application Software	5.6.4 Application Functions based Controls	5.28 & 5.30 – 5.31
		Fig. 5.6.1 Types of Application Controls	5.29
		5.7.1 Virtualization	5.33 – 5.35
		5.7.2 Grid Computing	5.35 – 5.42

## STUDY PLAN – KEY TO EFFECTIVE LEARNING

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The primary objective for the inclusion of the 'Information Technology' at Intermediate (IPC) Level of the Chartered Accountancy course is to provide conceptual understanding of different aspects of Information Systems, Business Processes and their automation and management. This paper provides a platform to students to build their conceptual understanding on Information systems, challenges, risks, threats and controls during implementation of Business Process Automation; much helpful for them while dealing with Paper 6: Information Systems Control and Audit at Final Level of their Chartered Accountancy Course.

The level of knowledge required for the subject is 'Working knowledge' and the objective is '**To develop understanding of Information Technology as a key enabler and facilitator of implementing Information Systems in enterprises and their impact on business processes and controls**'. For this, students have to focus their study on fundamental comprehension of business processes; and automation of various business processes through Business Information Systems. Besides, students should also give due importance to the terms/definitions for proper conceptualization of the answers. The detailed learning objectives of the paper are given below:

- To be familiar with the concept of Business Processes, Business Process Management (BPM), Business Process Re-Engineering (BPR) and representation of these business processes using different mapping systems like Entity Diagrams, DFDs, Decision Trees and some more.
- To understand the importance of auditing in Business Processes, phases of System Development Life Cycle (SDLC) and overview of Information Systems layers.
- To comprehend the topics on fundamentals, components and functioning of Telecommunication systems, different types of networks and their architectures.
- To have a detailed understanding of various types of Business Information Systems (like Management Information Systems, Knowledge Management Systems, Office Automation Systems etc.) and also some specialized systems like Core Banking System, Customer Relationship Management, Enterprise Resource Planning, Core Banking System etc. used world wide.
- To acquire an insight about various controls during Business Process Automation, latest technological devices, popular computing models and emerging concepts like Virtualization, Grid Computing, and Cloud Computing.

## **A. Planning your study**

### **1. Draw up a detailed study plan and allocate time for each topic/chapter of the subject**

- Make a study plan covering the entire syllabus and then decide how much time you can allocate to the subject on daily/weekly basis.
- Maintain the time balance amongst various subjects such as purely descriptive type and numerical-based papers.
- First of all, have an overview of the chapter to understand the broad contents and sequence of various sub-topics.
- Do the introspection while going through the chapter and ask various questions to yourself.
- Read each chapter slowly to ensure that you understand and assimilate the main concept. If need be, read once again with concentration and then try to attempt questions and exercises given in the Practice Manual.
- Recapitulate the main concept after going through each chapter by way of brief notes.
- Always assess your preparation periodically, say, on monthly basis. If necessary, revise your plan and allocate more time for the subject in which you feel deficient.
- Read, understand and assimilate each chapter.
- Preparation of the subject should never be selective in any case. Because broad coverage of the syllabus is more important than preparing 2-3 chapters exhaustively.
- Jot down the key points, in each topic while reading, that would facilitate revision, especially when you have a limited time of just one day before each examination.

### **2. Make full use of BoS Knowledge inputs in a systematic pattern**

The Board of Studies brings out various publications from time to time with a view to assist the students in education. You are advised to make full use of the Study Material and other educational inputs provided to you in the hard copy mode and also in the soft copy format under BoS Knowledge Portal under the Students' section of the Institute's website [www.icaai.org](http://www.icaai.org). Study Material lays a strong foundation of the understanding of any particular topic in detail. After having a fair idea about the topic from the study material, attempt the questions from the practice manual, Revision Test Papers etc.

### **3. Chapter-wise Tips for Preparation**

While studying IT paper, students should try to understand the linkages between the chapters at macro-level. This will help them in recollecting the concepts during examination. We have made an attempt to explain with the help of tabular format given here under the manner in which concepts contained in the particular chapter of the study

material have to be interlinked with another chapter of the study material and read together:

Inter - linked Chapter No(s).	Name of the Chapter(s)	Inter-linked Topic(s)
1	Business Process Management & IT	Business Process Automation
2	Information Systems and IT Fundamentals	
5	Business Process Automation through Application software	
2	Information Systems and IT Fundamentals	Cloud Computing
5	Business Process Automation through Application software	
3	Telecommunication and Networks	e-Commerce and m-Commerce technologies and Payment Mechanisms
4	Business Information Systems	

- During preparation of the first chapter, students should understand the concepts of various business processes and their representation through various mapping systems and how these business processes are impacted by IT. Students should pay emphasis on bringing a clarity on Business Process Management's principles and practices and their implementation in a structured manner to have better understanding of them. Further, students should understand various business processes flows before representing them with the help of any mapping system.
- Consequently in the second chapter, students should stress on comprehending IT fundamentals and the emerging technologies/devices helpful in automating business processes. To provide better understanding of the Information systems, the Information Systems Life Cycle is incorporated in this chapter. Further an overview of latest devices and technologies used nowadays has been incorporated in the chapter to keep you updated.
- The third chapter deals with telecommunication and networking concepts which lay a foundation for a student to comprehend working of Internet, e-commerce and m-commerce. The understanding of these concepts is the hour of need. Students may draw comparative analysis on different architectures, topologies, transmission modes after establishing the topic clarity. Also Network Security is the major concern area, so the chapter provides an overview of different security measures that can be adopted against network threats, risks and vulnerabilities.
- The fourth chapter links the concepts of first three chapters and gives an insight about different business information systems and their reporting through Information



Technology and different online payment mechanisms. Students will get a fair idea about different types of Information Systems and their advantages in the real time world while reading this chapter.

- In the last chapter, students should appreciate numerous business applications and the emerging technologies in the IT field like Cloud Computing, Grid computing etc. The controls needed in Business Process Automation from an auditors' perspective are dealt here in depth. The content of the chapter has been drafted in a comprehensive manner to enable the students to prepare in a better way for their examination.

#### **B. Tips for Examination**

- For the theoretical question, the answer should be laid down in bullets with brief description given in small paragraphs for making answer more appealing and legible.
- Make sure that your handwriting is neat and legible. Answer all parts of a question one after the other. Do not answer different parts of the same question at different places.
- Plan your time so that equal time is awarded for each mark. Keep sometime for revision as well.
- In case a question leaves room for making an assumption and there is a possibility of more than one assumption, it is important to clearly state the assumption you have taken and solve the question accordingly.
- Always attempt to do all questions. Remember that six average answers fetch more marks than five best answers. Therefore, it is important that you must finish each question within allocated time.
- Read the question carefully more than once before starting the answer to understand very clearly as to what is required by the paper-setter.
- Always be concise and write to the point and do not try to fill pages unnecessarily.
- There must be logical expression of the answer.
- Wherever possible, students should try to include relevant diagrams, tables, rough sketch etc.
- Revise your answers carefully and underline important points before leaving the examination hall.

#### **C. To conclude**

Last but not the least, remember that study will not be an arduous task if it is approached with a positive attitude and pursued with interest. If you enjoy your study; your learning will be permanent and profound. Always bear in mind that your own resolution to succeed is more important than any other. Therefore, give your hundred percent and there will be no looking back.

**Best Wishes and Happy Learning!!!**

# SYLLABUS

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## Paper - 7A: Information Technology (50 Marks)

**Level of Knowledge:** Working Knowledge

**Objective:** “To develop understanding of Information Technology as a key enabler and facilitator of implementing Information Systems in enterprises and their impact on business processes and controls”.

### Contents

- 1. Business Process Management & IT:** Introduction to various Business processes – Accounting, Finances, Sale, Purchase etc. Business Process Automation – Benefits & Risks, Approach to mapping systems: Entity Diagrams, Data Flow Diagrams, Systems Flow diagrams, Decision Trees/tables, Accounting systems vs. Value chain automation. Information as a business asset, Impact of IT on business processes. Business Risks of failure of IT, Business Process Re-engineering
- 2. Information Systems and IT Fundamentals:** Understand importance of IT in business and relevance to Audit with case studies. Understand working of computers and networks in business process automation from business information perspective. Concepts of Computing (Definition provided by ACM/IEEE and overview of related terminologies). Overview of IS Layers – Applications, DBMS, systems software, hardware, networks & links and people. Overview of Information Systems life cycle and key phases. Computing Technologies & Hardware – Servers, end points, popular computing architectures, emerging computing architectures & delivery models – example: SaaS, Cloud Computing, Mobile computing, etc., Example: Overview of latest devices/technologies – i5, Bluetooth, Tablet, Wi-Fi, Android, Touchpad, iPad, iPod, Laptop, Notebook, Smartphone, Ultra- Mobile PC etc.
- 3. Telecommunication and Networks:** Fundamentals of telecommunication, Components and functions of Telecommunication Systems. Data networks – types of architecture, LAN, WAN, Wireless, private and public networks etc., Overview of computing architectures – centralized, de-centralized, mainframe, client-server, thin-thick client etc. Network Fundamentals – Components, Standards and protocols, Network risks & controls – VPN, Encryption, Secure protocols. Network administration and management – concepts and issues. How information systems are facilitated through telecommunications. How Internet works, Internet architecture, key concepts, risks and controls, e-Commerce and M-commerce technologies
- 4. Business Information Systems :** Information Systems and their role in businesses, IT as a business enabler & driver – ERP, Core Banking System, CRM, SCM, HRMS, Payment Mechanisms. The relationship between organizations, information systems and business

processes, Accounting Information Systems and linkages to Operational systems, Business Reporting, MIS & IT. Organization Roles & responsibilities and table of authorities, importance of access controls, privilege controls. Specialized systems - MIS, DSS, Business Intelligence, Expert Systems, Artificial Intelligence, Knowledge Management systems etc.

**5. Business Process Automation through Application software:** Business Applications – overview and types, Business Process Automation, relevant controls and information systems. Information Processing & Delivery channels and their role in Information Systems. Key types of Application Controls and their need. Emerging concepts – Virtualization, Grid Computing, Cloud delivery model.



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# Business Process Management & IT

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## Learning Objectives

- ◆ To understand the concepts of Business Process Management (BPM) and Business Process Reengineering (BPR) in bringing about integration and significant improvement in business processes;
- ◆ To understand the different approaches used in mapping business systems and the significance of each approach;
- ◆ To understand the impact of Information Technology (IT) on BPM and the payback achieved by implementing BPM packages; and
- ◆ To understand benefits and risks of implementation of BPM and BPR projects.

## Task Statements

- ◆ To evaluate the BPM Principles and Practices in order to determine whether the goals of BPM exercise are achieved effectively and efficiently;
- ◆ To determine whether the implementation of BPM is done in a structured manner following the different phases of BPM life cycle;
- ◆ To determine whether the business strategy and operational goals have been appropriately translated into organizational, operational and implemented business process;
- ◆ To conduct reviews to determine the appropriateness of the approach adopted in mapping systems;
- ◆ To determine whether the re-engineered business processes have succeeded to achieve significant improvements in profits, customer-satisfaction, quality, deliveries, etc;
- ◆ To evaluate the payback achieved by implementing an integrated BPM system in an enterprise in terms of time and cost savings; and
- ◆ To evaluate the business risks involved in the implementation of BPM and the necessary controls to ensure success.

### Knowledge Statements

- ◆ Knowledge of key concepts, terms, methodologies and techniques used in Business Process Management (BPM);
- ◆ Knowledge of the practices that are making "process thinking" a new approach to solving business problems and are relentlessly recuperating organizational performance;
- ◆ Knowledge of key capabilities of BPM systems;
- ◆ Knowledge of the different phases of BPM lifecycle – evaluation, design, configuration & enactment and the elements involved in BPM implementation;
- ◆ Knowledge of classification of business processes into different levels of business process management – business strategy, operational goals, organizational business processes, operational business processes and implemented business processes;
- ◆ Knowledge of application of BPM solution to Accounts – the study of various processing cycles involved in Accounts and integrating them using Accounts BPM solution;
- ◆ Knowledge of different approaches to mapping systems – Entity Relationship Diagrams, Data Flow Diagrams, Systems Flow Diagrams, System Outline Charts, Decision Trees, Decision Tables, etc;
- ◆ Knowledge of the key concepts, terms, methodologies and techniques used in Business Process Reengineering (BPR);
- ◆ Knowledge of the impact of IT on BPM and the criteria for determining the payback achieved through implementing integrated BPM systems; and
- ◆ Knowledge of the numerous stumbling-blocks that organizations face while implementing BPM systems and reasons for the same.

## 1.1 Introduction

This chapter provides key concepts, terms, methodologies and techniques for implementing BPM. It provides details of how BPM implementation is done in a structured manner through different phases of a BPM life cycle. Further, it provides an overview of how to evaluate the BPM Principles and Practices so as to determine whether the goals of BPM exercise are achieved effectively and efficiently. Automation plays a major role in BPM. Hence, the need for automation and how business process automation can be achieved is also explained. With these objectives in mind, let us understand what is BPM and how does it work.

## 1.2 Overview of Business Processes

Information technology (IT) has steadily gained prominence in the management suites of large enterprises. With the advent of new business process- and internet-based technologies, we

have entered a new technological world with a new process-based design and implementation framework to employ business solutions. In this new technological world, business process designers are directly involved in systems design. The closer working relationship between business process designers and IT helps to reduce the gap between the business requirement and the final deployed solution.

The key concept of Business Process Management (BPM) is the convergence of technologies with process management theories.

### 1.2.1 What is a Process?

In the systems engineering arena, a **Process** is defined as a sequence of events that uses inputs to produce outputs. This is a broad definition and can include sequences as mechanical as reading a file and transforming the file to a desired output format; to taking a customer order, filling that order, and issuing the customer invoice.

From a business perspective, a **Process** is a coordinated and standardized flow of activities performed by people or machines, which can traverse functional or departmental boundaries to achieve a business objective and creates value for internal or external customers.

### 1.2.2 What is a Business Process?

A **Business Process** consists of a set of activities that are performed in coordination in an organizational and technical environment. These activities jointly realize a business goal. Each business process is enacted by a single organization, but it may interact with business processes performed by other organizations. To manage a process-

- ◆ The first task is to **define** it. This involves defining the steps (tasks) in the process and mapping the tasks to the roles involved in the process.
- ◆ Once the process is mapped and implemented, **performance measures** can be established. Establishing measurements creates a basis to improve the process.
- ◆ The last piece of the process management definition describes the **organizational setup** that enables the standardization of and adherence to the process throughout the organization. Assigning enterprise process owners and aligning employees' performance reviews and compensation to the value creation of the processes could accomplish this.

Process management is based on a view of an organization as a system of interlinked processes which involves concerted efforts to map, improve and adhere to organizational processes. Whereas traditional organizations are composed of departments and functional stages, this definition views organizations as networks or systems of processes. Process orientation is at the core of BPM. Hence, it is important to get understand clearly the distinction between the traditional functional organization and process organization. The following table provides the distinction between functional versus process organization as discussed in the Table 1.2.1.

Table 1.2.1: Functional versus Process Organization\*

	Functional Organization	Process Organization
<b>Work Unit</b>	Department	Team
<b>Key Figure</b>	Functional Executive	Process Owner
<b>Benefits</b>	<p>Focus on functional excellence.</p> <p>Easier to implement work balancing because workers have similar skills.</p> <p>Clear management direction on how work should be performed.</p>	<p>Responsive to market requirements.</p> <p>Improved communication and collaboration between different functional tasks.</p> <p>Performance measurements aligned with process goals.</p>
<b>Weaknesses</b>	<p>Barrier to communication between different functions.</p> <p>Poor handover between functions that affects customer service.</p> <p>Lack of end-to-end focus to optimize organizational performance.</p>	<p>Duplication of functional expertise.</p> <p>Inconsistency of functional performance between processes.</p> <p>Increased operational complexity.</p>
<b>Strategic Value</b>	Supports cost leadership strategy.	Supports differentiation strategy.

As illustrated above, process enterprise holds the promise of being more responsive to market requirements, and it is suited for companies that offer differentiated products/services rather than competing on cost alone. However, organizational realignment by itself does not result in improvements. The departments that are process complete perform manufacturing processes, support tasks, and customer interfacing, whereas the departments that are traditionally functional do not perform most activities outside of the manufacturing processes.

### 1.2.3 Business Process Flow

As discussed earlier, a **Business Process** is a prescribed sequence of work steps performed in order to produce a desired result for the organization. A business process is initiated by a particular kind of event, has a well-defined beginning and end, and is usually completed in a

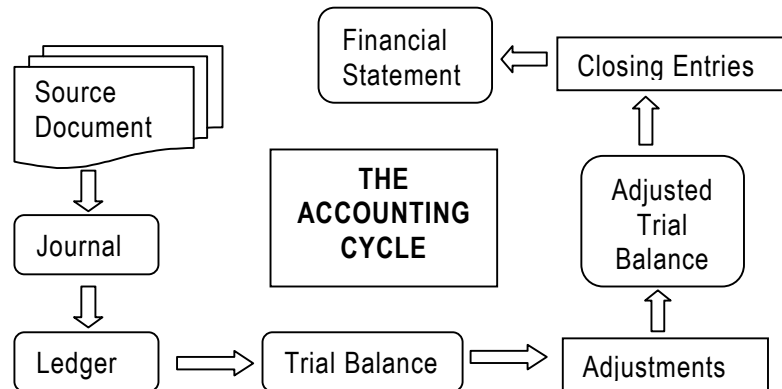
\*"Business Process Management Systems, Strategy and Implementation", James. F Chang, Auerbach Publications, Page No. 21

relatively short period. Organizations have many different business processes such as completing a sale, purchasing raw materials, paying employees and paying vendors, etc. Each of the business processes has either a direct or indirect effect on the financial status of the organization. The number and type of business processes and how the processes are performed would vary across enterprises and is also impacted by automation. However, most of the common processes would flow a generic life cycle. Examples of key business processes pertaining to accounting, sales and purchase are explained below.

### A. Accounting

**Accounting or Book keeping** cycle covers the business processes involved in recording and processing accounting events of a company. It begins when a transaction or financial event occurs and ends with its inclusion in the financial statements.

A typical life cycle of an accounting transaction may include the following transactions as depicted in Fig. 1.2.1:

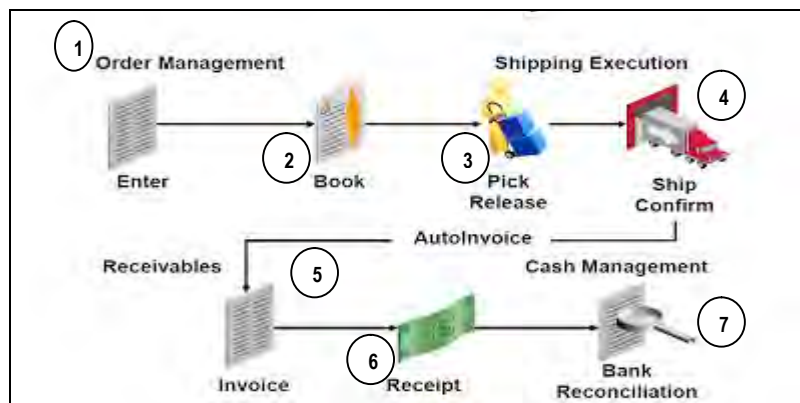


**Fig. 1.2.1: Accounting Process Flow**

- (a) **Source Document:** A document that captures data from transactions and events.
- (b) **Journal:** Transactions are recorded into journals from the source document.
- (c) **Ledger:** Entries are posted to the ledger from the journal.
- (d) **Trial Balance:** Unadjusted trial balance containing totals from all account heads is prepared.
- (e) **Adjustments:** Appropriate adjustment entries are passed.
- (f) **Adjusted Trial balance:** The trial balance is finalized post adjustments.
- (g) **Closing Entries:** Appropriate entries are passed to transfer accounts to financial statements.
- (h) **Financial statement:** The accounts are organized into the financial statements.

## B. Sales

**Order to Cash (OTC or O2C) or Sales** covers all the business processes relating to fulfilling customer requests for goods or services. It involves transactional flow of data from the initial point of documenting a customer order to the final point of collecting the cash.



**Fig. 1.2.2: Order to cash process flow**

The typical life cycle of a sales transaction which may include the following transactions are depicted in Fig. 1.2.2 given here:

- (i) **Customer Order:** A purchase order is received from a customer specifying the type, quantity and agreed prices for products.
- (ii) **Recording:** Availability of the items is checked and customer order is booked.
- (iii) **Pick release:** The items are moved from the warehouse to the staging area.
- (iv) **Shipping:** The items are loaded onto the carrier for transport to the customer.
- (v) **Invoice:** Invoice of the transaction is generated and sent to the customer.
- (vi) **Receipt:** Money is received from the customer against the invoices.
- (vii) **Reconciliation:** The bank reconciliation of all the receipts is performed.

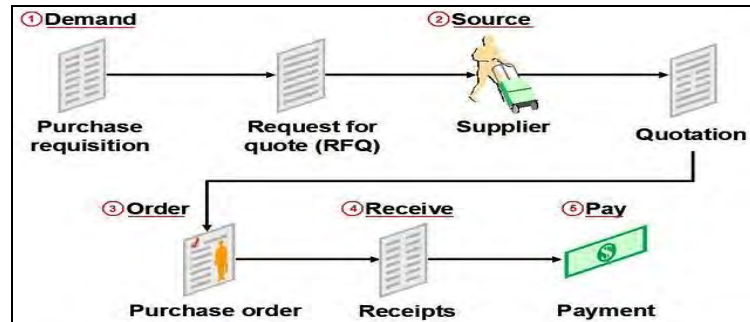
## C. Purchase

**Procure to Pay (Purchase to Pay or P2P)** cycle covers all the business processes relating to obtaining raw materials required for production of a product or for providing a service. It involves the transactional flow of data from the point of placing an order with a vendor to the point of payment to the vendor.

Typical life cycles of a purchase transaction which may include the following transactions are depicted in Fig. 1.2.3.

- (a) **Purchase requisition:** A document is prepared requesting the purchase department to place an order with the vendor specifying the quantity and time frame.

- (b) **Request for quote:** An invitation is sent to the vendors to join a bidding process for specific products.

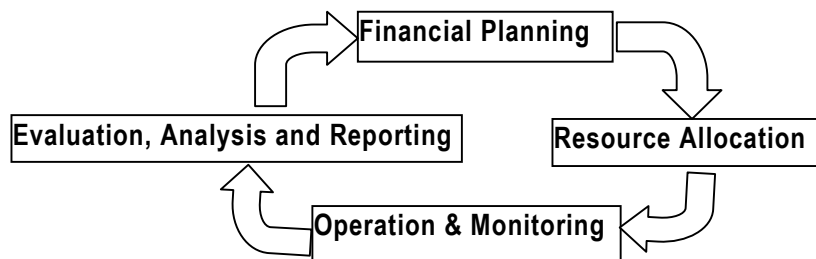


**Fig. 1.2.3: Procure to Pay Process flow**

- (c) **Quotation:** The vendors provide cost quotations for the supply of products.
- (d) **Purchase order:** A commercial document is issued to the vendor specifying the type, quantity and agreed prices for products.
- (e) **Receipts:** The physical receipt of goods and invoices.
- (f) **Payments:** The payments are made against the invoices.

#### D. Finances

Finance is one of the most important and limited resources available with government. Its proper use can help target areas of need, bring in efficiency and improve services. For us, helping governments and their agencies use their funds better is one of the tenets of good governance – bringing in efficient systems and accountability in management of the limited public resource.



**Fig. 1.2.4: Financial Management Life Cycle**

Specialized team of professionals work in all aspects of the financial management cycle (shown in the Fig. 1.2.4) and help to reinforce economic and financial management through fiscal discipline and financial integrity. From the financial planning stage to resource allocation, monitoring and analysis, at every step of the way, governments and agencies ensure that public resources are used effectively and reach the intended beneficiaries.

### 1.3 Classification of Business Processes

Business processes are pervasive in any organization and represent all activities that an organization undertakes. Businesses try to improve on these operations or processes as a process improvement project. This requires using advanced methodologies and technologies to deliver consistent, repeatable, and more efficient outcomes by the improvement project. BPM helps to define and manage the business processes to reach the desired goals.

Business processes are broadly classified into two categories. These are as follows:

1. 'Organizational' Business Processes and
2. 'Operational' Business Processes.

Different levels can be identified in business process management, ranging from high-level business strategies to implemented business processes. These levels are depicted in Fig. 1.3.1 and are explained here.

**A. Business Strategy:** At the highest level, the **strategy** of the company is specified, which describes its long-term concepts to develop a sustainable competitive advantage in the market. An example of a business strategy is cost leadership for products in a certain domain.

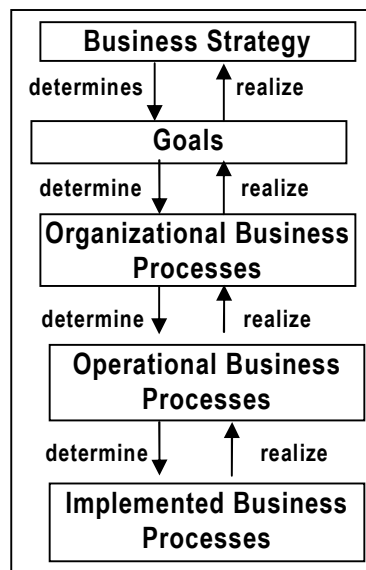


Fig. 1.3.1: Levels of Business Processes: from business strategy to implemented business processes\*

\*"Business Process Management, Concepts, Languages and Architectures", Mathias M Weske, Springer, Page No. 18



**B. Goals:** At the second level, the business strategy is broken down to **Operational Goals**. These goals can be organized, so that each goal can be divided into a set of sub-goals. Reducing the cost for supplied materials is a sample goal that contributes to the realization of the business strategy mentioned.

**C. Organizational Business Processes:** **Organizational business processes** are high-level processes that are typically specified in textual form by their inputs, their outputs, their expected results and their dependencies on other organizational business processes. These business processes act as supplier or consumer processes. To manage incoming raw materials provided by a set of suppliers is an example of an organizational business process.

While organizational business processes characterize coarse-grained business functionality, there are multiple operational business processes that contribute to one organizational business process.

**D. Operational Business Processes:** In **Operational Business Processes**, the activities and their relationships are specified, but implementation aspects of the business process are disregarded. Operational business processes are specified by business process models. These are the basis for developing implemented business processes.

**E. Implemented Business Processes:** **Implemented Business Processes** contain information on the execution of the process activities and the technical and organizational environment in which they will be executed.

## 1.4 Business Process Management

**Business Process Management (BPM)** refers to the closed loop, iterative management of business processes over their complete lifecycle. In simple terms, BPM is about the management of business processes with the organization being the primary focus. It is the methodology used by enterprises to improve end-to-end business processes in various stages and aim to grow revenues quickly while controlling resource costs.

BPM may be defined as: “**The achievement of an organization’s objectives through the improvement, management and control of essential business processes**”. All the key terms of the definition are explained below.

- ◆ **Achievement:** Realizing the strategic objectives as outlined in the organization’s strategic plan. At a project level, it is about realizing the value or business benefits as outlined in the project business case.
- ◆ **Organization:** The organization in this context refers to an enterprise or parts of an enterprise, perhaps a business unit that is discrete in its own right. It is the end-to-end business processes associated with this part of an organization. This end-to-end focus will ensure that a silo approach does not develop.
- ◆ **Objectives:** The objectives of a BPM implementation range from the strategic goals of the organization through to the individual process goals. It is about achieving the

## 1.10 Information Technology

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business outcomes or objectives. BPM is not an objective in itself, but rather a means to achieving an objective. It is not 'a solution looking for a problem'.

- ◆ **Improvement:** It is about making the business processes more efficient and effective.
- ◆ **Management:** It refers to the process and people - performance measurement and management. It is about organizing all the essential components and subcomponents for a processes. By this we mean arranging the people, their skills, motivation, performance measures, rewards, the processes themselves and the structure and systems necessary to support a process.
- ◆ **Control:** It has been said that BPM is about managing our end-to-end business processes and involves the full cycle of plan-do-check-act. An essential component of control is to have the ability to measure correctly. If we cannot measure something, we cannot control and manage it.
- ◆ **Essential:** Not every process in an organization contributes towards the achievement of the organization's strategic objectives. Essential processes are the ones that do.
- ◆ **Business:** An implementation of BPM must have an impact on the business by delivering benefits. It should focus on the core business processes that are essential to our primary business activity – those processes that contribute towards the achievement of the strategic objectives of the organization.
- ◆ **Processes:** A process comprises all the things we do to provide someone who cares with what they expect to receive. The lifecycle of an end-to-end process is from the original trigger for the process to the ultimate stakeholder satisfaction. The final test of a process's completeness is whether the process delivers a clear product or service to an external stakeholder or another internal process.

Therefore, we may say that BPM evaluates the efficacy and usefulness of business processes for reducing costs and ensure value creation. It includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes. The basis of BPM is the explicit representation of business processes with their activities and the execution constraints between them. Once business processes are defined, they can be subject to analysis, improvement, and enactment. A Business Process Management System (BPMS) is a generic software system that is driven by explicit process representations to coordinate the enactment of business processes. BPM is at the core of enterprises which aim to grow revenues quickly while controlling resource costs. The primary benefit of using technology for BPM are –

- (i) the effectiveness gains for enterprises through the automated coordination of activities;
- (ii) distribution of tasks to process participants and the amalgamation of applications; and
- (iii) creation of basic operational value proposition – which is the ability to process more with less effort and higher quality.

### 1.4.1 Business Process Management Principles and Practices

The primary goal of BPM is to improve products and services through structured approach to performance improvement that centers on systematic design and management of a company's business processes. Let us understand some of the key BPM principles and practices. The BPM principles and Practices are summarized in the Table 1.4.1 given below:

#### BPM's Principles

1. BPM's first principle is **processes are assets** that create value for customers. They are to be managed and continuously improved. Because processes are assets, core processes and processes that generate the most value to customers should be carefully managed.
2. A managed process produces consistent **value to customers** and has the foundation for the process to be improved. Management of processes entails the tasks of measuring, monitoring, controlling, and analyzing business processes. Measuring of business processes provides information regarding these business processes. Process information allows organizations to predict, recognize, and diagnose process deficiencies, and it suggests the direction of future improvements.
3. The third principle is **continuous improvement** of processes. This is a natural result of process management. Process improvement is facilitated by the availability of process information. The business environment usually dictates that organizations need to improve to stay competitive. Business processes are central to an organization's value creation. It follows that processes should be continuously improved.

**Table 1.4.1: BPM Principles and Practices\***

<b>Principles</b>	<ul style="list-style-type: none"> <li>▪ Business processes are organizational assets that are central to creating value for customers;</li> <li>▪ By measuring, monitoring, controlling, and analyzing business processes, a company can deliver consistent value to customers;</li> <li>▪ As the basis for process improvement - business processes should be continuously improved; and</li> <li>▪ Information technology is an essential enabler for BPM.</li> </ul>
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\* "Business Process Management Systems, Strategy and Implementation", James. F Chang, Auerbach Publications, Page No. 31

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<b>Practices</b>	<ul style="list-style-type: none"><li>▪ Strive for process-oriented organizational structure;</li><li>▪ Appoint process owners;</li><li>▪ Senior management needs to commit and drive BPM and execution of BPM process improvements should take a bottom-up approach;</li><li>▪ Put in place information technology systems to monitor, control, analyze, and improve processes;</li><li>▪ Work collaboratively with business partners on cross-organizational business processes;</li><li>▪ Continuously train the workforce and continuously improve business processes;</li><li>▪ Align employee bonuses and rewards to business process performance;</li><li>▪ Utilize both incremental (e.g., Six Sigma) and more radical (e.g., BPR) methodologies to implement process improvement</li></ul>
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### BPM's Practices

1. **Process-oriented organizational structure:** Processes are the core assets of an organization, and they produce the values that justify an organization's existence. In order for processes to be effectively managed and improved, BPM identifies three types of process-oriented structures:
  - (a) **Process Organization** - This aligns the organizational structure along process lines. Each process unit would contain various functions that support the process. The advantage of process organization is that it optimizes the performance of the process.
  - (b) **Case management organization** - In this organizational structure, employees would still report to functional heads. In addition, they would report to case managers. The case manager has the responsibility to oversee the end-to-end process of an individual case.
  - (c) **Horizontal process management organization** - The organization would create process owners who are responsible for core processes. The core processes could be order-to-cash, product development, purchase-to-pay, etc.
2. **Appoint Process Owners:** The process owners are assigned to the core processes who are responsible for the performance of the process assigned. The process owner designs, deploys, and improves the process and is responsible for influencing functional workers and functional heads on how best to perform functions associated with the process. The process owner should be a senior member of the organization who has the power to influence other senior managers.

3. **Top-Down Commitment, Bottom - Up Execution:** In order for BPM to work, top management needs to commit to it and support the process-focused management approach it requires. Undoubtedly, organizations adopting BPM will go through difficulties and oppositions. Without top management commitment, BPM will likely to disappear because of internal organizational resistance. Executing process improvement should use a bottom-up approach. The benefit of a bottom-up approach is it encounters less resistance from the employees most directly affected by the change.
4. **Use Information Technology (IT) to Manage Processes:** BPMS aligns the IT solution to be more in line with the process and once implemented, allows organizations to measure, monitor, control, and analyze processes real time.
5. **Collaborate with Business Partners:** Increasingly companies are getting more and more focused on what they want to perform in house and what to be outsourced. Thus, it is necessary to extend process management outside the enterprise that involves sharing information with business partners and helping business partners with their business processes.
6. **Continuous Learning and Process Improvement:** In the BPM world, employees will be introduced to new technologies and work activities. In a process-focused environment, workers belong to processes and they can be expected to perform broader sets of tasks than in traditional functional organizations. The broadening of tasks workers are expected to perform and new technologies that are implemented to support BPM require workers to be up to date on their skills and knowledge. BPM organizations thrive on continuous improvement.
7. **Align Employee Rewards to Process Performance:** In the BPM organization, delivering customer value and optimizing process performance are two central goals. When employee rewards are aligned to process performance, they further collaborate among workers who are engaged in the same process in order to increase the business process performance.
8. **Utilize BPR, TQM, and Other Process Improvement Tools:** Many business process experts describe BPM as the convergence of business process improvement approaches. Under the BPM approach, the previous process-focused business improvement approaches could be seen as tools for improving the processes. For example - Six Sigma (Define, Measure, Analysis, Improve, and Control (DMAIC)) could be deployed for incremental improvements.

#### 1.4.2 Business Process Management Life Cycle

**BPM Life Cycle (BPM-L Cycle):** An Enterprise Resource Planning (ERP) application divides BPM into the following phases:

- (i) **Analysis phase:** This involves analysis of the current environment and current processes, identification of needs and definition of requirements.

- (ii) **Design phase:** This involves evaluation of potential solutions to meet the identified needs, business process designing and business process modeling.

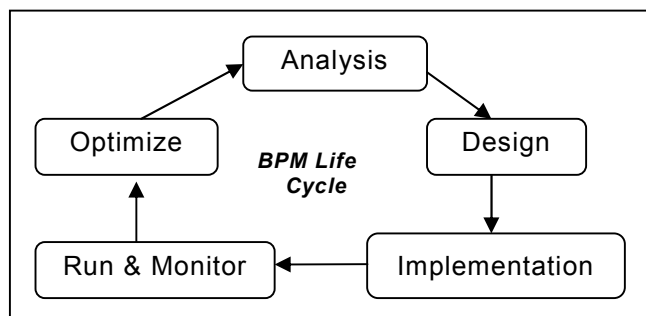


Fig. 1.4.2: BPM Life Cycle

- (iii) **Implementation phase:** This involves project preparation, blue printing, realization, final preparation, go live and support.
- (iv) **Run and Monitor phase:** This involves business process execution or deployment and business process monitoring.
- (v) **Optimize:** Iterate for continuous improvement.

## 1.5 Theories of Process Management

At the heart of BPM is the continuous search for ways to progress proficiently. BPM is a combination of systems, methods and tools for ensuring processes that are improved on a continuous basis to achieve enterprise objectives.

Under the BPM framework, **Business Process Re-engineering (BPR)** and incremental process improvement methodologies (i.e., **Six Sigma**, **TQM**, etc.) are tools that organizations can use to implement process improvement. With a focus on continuous improvement, an organization is better prepared to face change, which is constant in our customer-oriented economy. This helps to develop a corporate culture that is process-oriented; ready to adapt to changes in management at the operational level; and is predominantly about the improvement and control of the processes essential to any business to achieve the objectives of the organization. Setting the direction and goals for business process improvement is a critical step that needs to be addressed by higher management. BPM has evolved with usage of combination of well-known organizational transformation concepts such as BPR, Six Sigma, and TQM; and process-supporting technologies such as workflow management, process analysis and automation suites, and service enabled systems.

### 1.5.1 Six Sigma

Six Sigma is a set of strategies, techniques, and tools for process improvement. It seeks to improve the quality of process outputs by identifying and removing the causes of defects and

minimizing variability in manufacturing and business processes. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits. It follows a life-cycle having phases: **Define, Measure, Analyze, Improve** and **Control** (or **DMAIC**) which are described as follows and shown in the Fig. 1.5.1.

- (i) **Define:** Customers are identified and their requirements are gathered. Measurements that are critical to customer satisfaction [Critical to Quality, (CTQ)] are identified for further project improvement.
- (ii) **Measure:** Process output measures that are attributes of CTQs are determined and variables that affect these output measures are identified. Data on current process are gathered and current baseline performance for process output measures are established. Variances of output measures are graphed and process sigma are calculated.
- (iii) **Analyze:** Using statistical methods and graphical displays, possible causes of process output variations are identified. These possible causes are analyzed statistically to determine root cause of variation.
- (iv) **Improve:** Solution alternatives are generated to fix the root cause. The most appropriate solution is identified using solution prioritization matrix and validated using pilot testing. Cost and benefit analysis is performed to validate the financial benefit of the solution. Implementation plan is drafted and executed.
- (v) **Control:** Process is standardized and documented. Before and after analysis is performed on the new process to validate expected results, monitoring system is implemented to ensure process is performing as designed. Project is evaluated and lessons learned are shared with others.

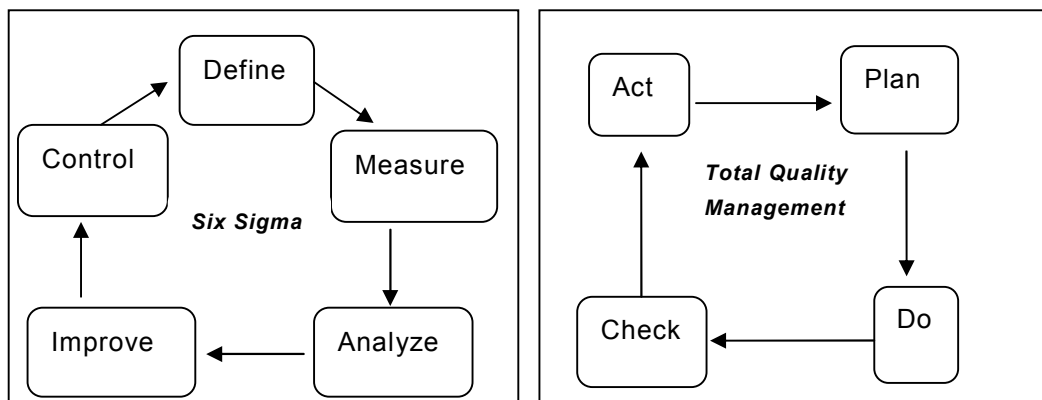


Fig. 1.5.1: Six Sigma and TQM Cycles

### 1.5.2 Total Quality Management (TQM)

It is the organization-wide effort to install and make permanent a climate in which it continuously improves its ability to deliver high-quality products and services to customers. Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinements in response to continuous feedback. TQM requirements may be defined separately for a particular organization or may be in adherence to established standards, such as the International Organization for Standardization's ISO 9000 series. TQM can be applied to any type of organization; it originated in the manufacturing sector and has since been adapted for use in almost every type of organization imaginable, including schools, highway maintenance, hotel management, and churches. As a current focus of e-business, TQM is based on quality management from the customer's point of view. TQM processes are divided into four sequential categories: **Plan**, **Do**, **Check**, and **Act** (the PDCA cycle) as shown in the Fig. 1.5.1.

- (i) **Plan:** In the planning phase, people define the problem to be addressed, collect relevant data, and ascertain the problem's root cause;
- (ii) **Do:** In the doing phase, people develop and implement a solution, and decide upon a measurement to gauge its effectiveness;
- (iii) **Check:** In the checking phase, people confirm the results through before-and-after data comparison;
- (iv) **Act:** In the acting phase, people document their results; inform others about process changes, and make recommendations for the problem to be addressed in the next PDCA cycle.

### 1.5.3 Business Process Reengineering (BPR)

Information Systems are valuable assets that knowledge workers can take advantage of. An important aspect of business process reengineering is combining small granular functions conducted by several persons into functional units of larger granularity, and supporting knowledge workers in performing these tasks with dedicated information systems. Business process management is based on the resources of an enterprise, most prominently on the information systems in place. Information systems enable knowledge workers to perform business process activities in an effective manner. Information systems also have implications on business processes, since some business processes might not be possible without appropriate information system support.

Business Processes need to be re-engineered so as enhance efficiencies or due to change in the processing systems or mechanism. **Business Process Reengineering** is based on the understanding that the products and services a company offers to the market are provided through business processes, and a radical redesign of these processes is the road to success.



The discipline which provides a systematic approach to manage and bring in transformational change is called **Business Process Reengineering (BPR)**. Although, there are many definitions of BPR, the most accepted and formal definition for Business Process Reengineering (BPR) is: **“BPR is the fundamental rethinking and radical redesign of processes to achieve dramatic improvement, in critical, contemporary measures of performance such as cost, quality, service and speed”**.

This has a few important key words, which need clear understanding:

- ◆ **Dramatic achievement** means to achieve 80% or 90% reduction (in say, delivery time, work in progress or rejection rate) and not just 5%, 10% reduction. This is possible only by making major improvements and breakthroughs, and not small incremental changes like in Total Quality Management (TQM).
- ◆ **Radical redesign** means BPR is reinventing and not enhancing or improving. In a nutshell, a “clean slate approach” of BPR says that “Whatever you were doing in the past is all wrong”, do not get biased by it or reassemble, the new system is to be redesigned afresh.
- ◆ **Fundamental rethinking** means asking the question “why do you do what you do”, thereby eliminating business processes altogether if it does not add any value to the customer. There is no point in simplifying or automating a business process which does not add any value to the customer. An example is that of asking for an invoice from the supplier for payment when the company has already received and accepted a particular quantity of materials physically and at an agreed price. Receiving, processing, and filing of invoices add no value to customer and make only the supplier unhappy for delayed payments.

Thus, BPR aims at major transformation of the business processes to achieve dramatic improvement. Here, the business objectives of the enterprise (e.g., profits, customer-satisfaction through optimal cost, quality, deliveries, etc.) are achieved by “transformation” of the business processes which may, or may not, require the use of Information Technology (IT). A radical rethinking on the way the business is run would bring the finest out of the organization. BPR is the main method by which organizations become more efficient and modern. It transforms an organization in ways that directly affect its performance.

### **BPR Success factors**

BPR implies not just change but dramatic change in the way a business functions. It would potentially impact every aspect of the business and the changes would be of a scale that could result in either drastic improvement or massive failures. Research has identified some key factors for BPR projects to succeed. These factors are as follows:

- (i) **Organization wide commitment:** Changes to business processes would have a direct impact on processes, organizational structures, work culture, information flows, infrastructure & technologies and job competencies. This requires strong leadership,

support and sponsorship from the top management. Top management not only has to recognize the need for change but also has to convince every affected group about the potential benefits of the change to the organization as a whole and secure their commitment.

- (ii) **BPR team composition:** A BPR team is formed which would be responsible to take the BPR project forward and make key decisions and recommendations. The BPR team would include active representatives from top management, business process owners, technical experts and users. It is important that the teams must be kept of manageable size (say 10 members) to ensure well-coordinated, effective and efficient completion of the entire BPR process.
- (iii) **Business needs analysis:** It is important to identify exactly what current processes need reengineering. This would help determine the strategy and goals for BPR. A series of sessions are held with the process owners and stakeholders and all the ideas would be evaluated to outline and conceptualize the desired business process. The outcome of this analysis would be BPR project plan – identifying specific problem areas, setting goals and relating them to key business objectives. This alignment of the BPR strategy with the enterprise strategy is one of the most important aspects.
- (iv) **Adequate IT infrastructure:** Adequate investment in IT infrastructure in line is of vital importance to successful BPR implementation. An IT infrastructure is a set of hardware, software, networks, facilities, etc. (including all of the information technology), in order to develop, test, deliver, monitor, control or support IT services. Effective alignment of IT infrastructure to BPR strategy would determine the success of BPR efforts.
- (v) **Effective change management:** BPR involves changes in people behavior and culture, processes and technologies. Hence, resistance would be a natural consequence which needs to be dealt with effectively. An effective change management process would consider the current culture to foster a change in the prevailing beliefs, attitudes and behaviors effectively. The success of BPR depends on how effectively management conveys the need for change to the people.
- (vi) **Ongoing continuous improvement:** BPR is an ongoing process hence innovation and continuous improvement are key to the successful implementation of BPR.

### 1.6 BPM Implementation

BPM is actually paper-based standard operating procedures taken to their most productive level – throughout the initiation of increasingly business-centric technological advances. As the business process may cover different people working in different departments, the organization should also consider allocating issues such as process owners, process managers, and the method of measuring the effectiveness and efficiency of a business process. This also implies that, with most organizations, the business and IT should be involved. In the end, the organization should develop a mindset that implementing BPM technology can contribute towards an organization becoming process-centric.

People are at the center of business processes and hence it is imperative to make them part of the solution. The key to a successful BPM implementation is to consider it not just as an improvement programs but make it an integral part of business strategy. An effective BPM implementation has to result in the institutionalization of process improvement as a fundamental management practice. This can be effectively achieved through proactive and predictive management of relevant business processes. BPM requires enterprise to align its' processes with enterprise goals, find ways to improve those processes and then establish measurements that can be used to track and monitor performance for continuous improvement and optimization. Processes are multi-functional and need to be properly integrated. Effective streamlining of process requires process management to be implemented. Process management is a functional group including (but not limited to) operations management, Supply Chain Management, Finance and Accounting, Marketing, and General Management. Process management provides a sequence of analytical tools that are essential to the modern project manager, analyst, and management consultant.

The payback of BPM implementation is enormous in any economic surroundings. But achieving business quickness in a turbulent, competitive global market is all the easier with BPM tools. Spread across industry sectors, these companies stand out for their quick come back to revolutionize, proficient cost structures, enhanced revenue models and optimal growth levels. By providing an adjustable structure to make key corporate decisions, BPM helps organizations optimize both work and revenues.

### 1.6.1 Key factors to consider in implementing BPM

Table 1.6.1 illustrates the key factors to be considered in implementing BPM.

**Table 1.6.1: Key factors and related considerations in implementing BPM**

<b>Factors</b>	<b>Key Considerations</b>
<b>Scope</b>	A single process, a department, the entire company
<b>Goals</b>	Process understanding, improvement, automation, re-engineering, optimization
<b>Methods to be used</b>	Six Sigma, BPM Life Cycle Method, TQM, Informal methods
<b>Skills Required</b>	Consultants, Train Employees, Formal Certification, Basic Education, Existing Skill sets
<b>Tools to be used</b>	White-Boards, Sticky Notes, Software For Mapping, Documenting, Software for Simulation, Comprehensive BPMS
<b>Investments to Make</b>	Training, Tools, Time
<b>Sponsorship/Buy-in Needed</b>	Executive Level, Department Level, Process Owner Level, Employee Level

## 1.6.2 Need for a BPM implementation

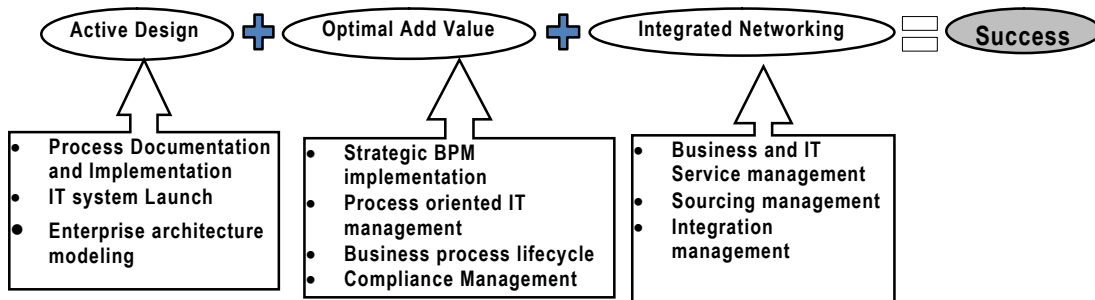


Fig. 1.6.1: BPM leads to success

Thus BPM will be the mechanism to:

- ◆ Create the long-term future positioning of the business and enhance its future capability;
- ◆ Create short-term cost effectiveness and improvement to current customer service;
- ◆ Initiate continuous improvement from the base of the current, but improved, processes;
- ◆ Introduce a knowledge of product and customer profitability;
- ◆ Re-engineer the business radically and provide clear future competitive differentiation;
- ◆ Address the cultural barriers that prevent effective cross-functional and hierarchical working;
- ◆ Introduce leadership and a role for managers and empowered staff.

Business processes are all around us, independent of the market, organization, department or function – whether a telecom operator providing an internet connection, a bank processing a loan application, an insurance company handling a claim, or a local government organization processing a request for a new passport. Any organization is the sum of its business processes and is the fundamental part of any organization's infrastructure as depicted in the Fig. 1.6.1. In all the above examples, the volume of work and the complexity of the business process demand that organizations look for possible IT applications to support and automate their processes.

Throughout the years, many companies have invested millions in all sorts of IT solutions. The marketing department has its Enterprise Content Management (ECM) system, used to inform the consumer of the organization's products or services. The sales department has a Customer Relation Management (CRM) system to allow the company to up- and cross-sell, and finally the delivery department has an Enterprise Resource Planning (ERP) system to process the order and send an invoice. The challenge for today's organizations is that these departments operate as independent functional units.

### 1.6.3 Automation of the functional units

The consumer is often confronted with poor customer service due to broken processes, inefficient processes and manual processes – that is, the customer is often confronted with the silos of the organization.

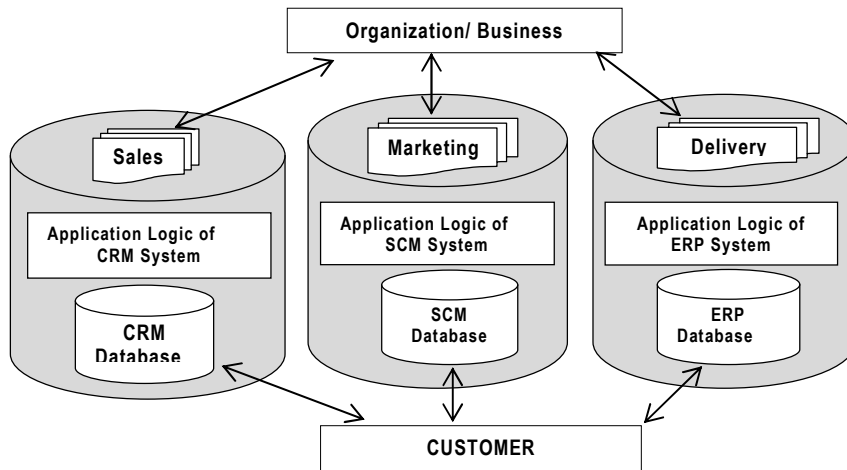


Fig. 1.6.2: Automation of the functional units

However, the same consumer is becoming more and more demanding with respect to delivery time – where customers used to expect and accept days or weeks for delivery, same time, the consumer is demanding higher quality of the products or services. Finally, the product or service is becoming more and more personalized (and thus more complex), supported by increased customer services. Refer to the Fig. 1.6.2.

### 1.6.4 Business Process Automation (BPA): Benefits & Risks

Business Process Automation (BPA) is a strategy that is used to optimize and streamline the essential business processes, using the latest technology to automate the functions involved in carrying them out. BPA allows the organizations to extract maximum benefit by using the available resources to their best advantage, while keeping the operational cost as low as possible. Doing so helps the enterprise to generate greater profits and achieve a level of stability that would be hard to realize without the use of automation.

The core objective of BPA is achieved through integrating various business processes. The key benefits and risks of BPA are given below:

#### Benefits

- ♦ **Saving on costs:** Automation leads to saving in time and labor costs.
- ♦ **Staying ahead in competition:** Today, in order to survive, businesses need to adopt automation.
- ♦ **Fast service to customers:** This was not the initial reason for adoption of BPA but gradually business managers realized that automation could help them to serve their customers faster and better.

### Risks

- ♦ **Risk to jobs:** Jobs that were earlier performed manually by several employees would post-automation would be mechanized, thereby posing a threat to jobs.
- ♦ **False sense of security:** Automating poor processes will not gain better business practices.

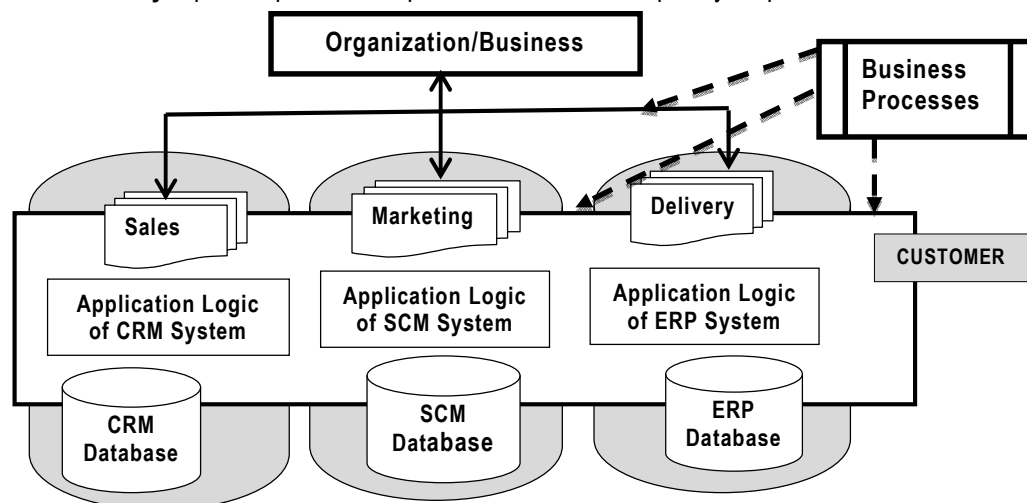
### 1.6.5 Challenges in implementing BPA

How can any organization adjust with these increased demands in an environment where, at the same time:

- ♦ The number of interfaces with the customers is growing (e.g. phone, fax, email, sms, PDA, etc.)
- ♦ The product, service and price options have increased the complexity of the business
- ♦ Most organizations have a whole suite of 'build and buy' systems and applications, often each with its own data format
- ♦ Budgets are being cut.

Organizations are realizing that all the organization's assets, systems, departments and people are interlinked. Referring to the Fig. 1.6.3, there are numerous internal processes that form an internal supply chain, which relate to the end-to-end process of the organization. Basically, one simple interface with the organization would be preferable:

- ♦ **Marketing** – what product or service do you have to offer?
- ♦ **Sales** – please treat me as one single client
- ♦ **Delivery** – please provide the product or service as quickly as possible.



**Fig. 1.6.3: Enterprise Business Systems: end-to-end customer processes.**

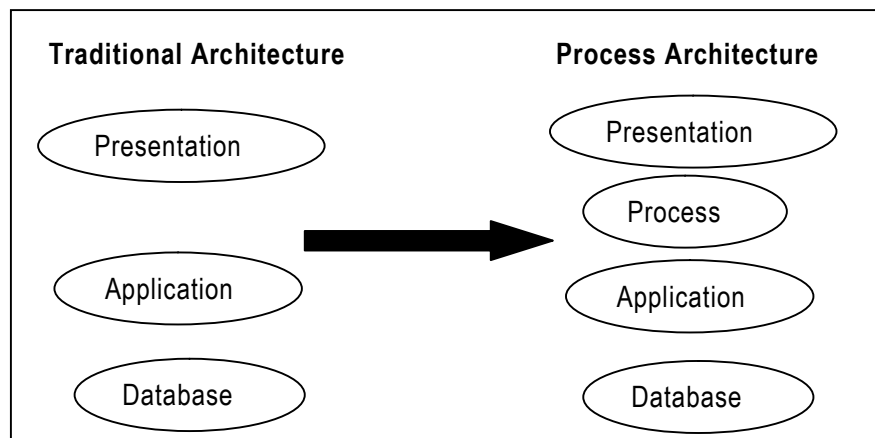
Realizing that an organization could be seen as a sum of its business processes is the key element in selling a BPM and automation is not just about implementing technology, it is also

about automating the business processes in the right circumstances. Existing applications can be linked to each other by an independent process layer. BPM automation is also about a new way of working, monitoring and managing the organization, which could result in a new organizational structure.

*For further details on BPA, students may refer to Chapter – 5 “Business Process Automation Through Application Software” of the Study Material of Intermediate (IPC) Course.*

### 1.6.6 BPM Technology

BPM technology can complement existing (and future) investments in applications and give organizations the ability to implement a real – time process improvement without the extensive process conversion efforts as the original business processes already exist. To achieve these benefits, Business Process Layer is introduced in the Traditional IT architecture. The traditional IT architecture contains three layers: Database, Application and Presentation. The Database layer physically contains data; Application Layer contains applications and process logic; and Presentation Layer is what users see. In Four-layered architecture, the Process Layer is situated between Presentation and Application Layer as shown in the Fig. 1.6.4.



**Fig. 1.6.4: Traditional Architecture versus Process Architecture\***

BPM provides an independent process layer, linking the various independent applications needed to execute a single end-to-end business process. BPM technology can then manage the flow of activities along different applications, and the people involved and also reduce execution time. By tracking the business process, an organization can monitor its performance and at the same time audit for compliance. Analyzing information helps to improve the business processes further. All this can increasingly be completed in real time; management

\* “Business Process Management Systems, Strategy and Implementation”, James. F Chang, Auerbach Publications, Page No. 56

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can make instant changes and validate if the changes are having the desired effect. Experience shows that organizations which are successful in exploiting BPM technology start by solving a specific business problem with a clear, short-term Return On Investment (ROI). Thus, anybody selling BPM, both internal and external to an organization, should consider both parts of the equation:

**BPM = Process and Organization (including people) as well as Technology**

### 1.6.7 Value Chain Automation

**Value chain** refers to separate activities which are necessary to strengthen an organization's strategies and are linked together both inside and outside the organization. It is defined as a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market.

The idea of the Value Chain is based on the process view of organizations, the idea of seeing a manufacturing (or service) organization as a system, made up of subsystems each with inputs, transformation processes and outputs. Value chain of a manufacturing organization comprises of Primary and Supportive activities. The primary ones are inclusive of inbound logistics, operations, outbound logistics, marketing and sales, and services. The supportive activities relate to procurement, human resource management, technology development and infrastructure. Six business functions of the value chain are as follows:

- ◆ Research and development
- ◆ Design of products, services, or processes
- ◆ Production
- ◆ Marketing and sales
- ◆ Distribution
- ◆ Customer service

Value Chain Analysis is a useful tool for working out how we can create the greatest possible value for our customers. IT helps us identify the ways in which we create value for our customers and then helps us think through how we can maximize this value: whether through superb products, great services, or jobs well done.

## 1.7 Accounting Systems Automation

An **Accounting Information System** which is known as **AIS** is defined as a system of collection, storage and processing of financial and accounting data that is used by decision makers. An Accounting Information System is generally a computer-based method for tracking accounting activity in conjunction with information technology resources. The resulting statistical reports can be used internally by management or externally by other interested parties including investors, creditors and tax authorities.



### 1.7.1 Basic Functions of an Accounting Information System (AIS)

Accountants and Auditors must study and understand AIS and related concepts so that they can accomplish the functions of accounting, general accounting reports and using accounting reports. The Accounting Information System is the mechanism that allows accountants to perform their accounting functions and tasks. Further, in automation of AIS, accountants and auditors need to be actively involved in evaluating which software to purchase, how to design the software or systems and implementation of the software or systems. As auditors in auditing AIS, understanding of AIS is critical for collecting and evaluating evidence to provide an opinion/report on the completeness and accuracy of accounting information which is processed through AIS to produce the financial reports. There are three basic functions of AIS and these are explained here.

- (i) **Collect and store data:** Collect and store data about organization's business activities and transactions by capturing transaction data from source documents and posting data from journals to ledgers. Source documents are special forms used to capture transaction data such as sales order, sales invoice, order processing, purchase order, etc. Control over data collection is improved by pre-numbering each source document. Accuracy and efficiency in recording transaction data can be further improved if source documents are properly designed. The Fig. 1.7.1 shows the system input documents through a system process flow namely source documents, product documents and turnaround documents.
- (ii) **Record transaction:** Record transactions data into journals. These journals present a chronological record of what occurred and provide management with information useful for decision making. These documents are in the form of reports like financial statements, managerial reports, etc.

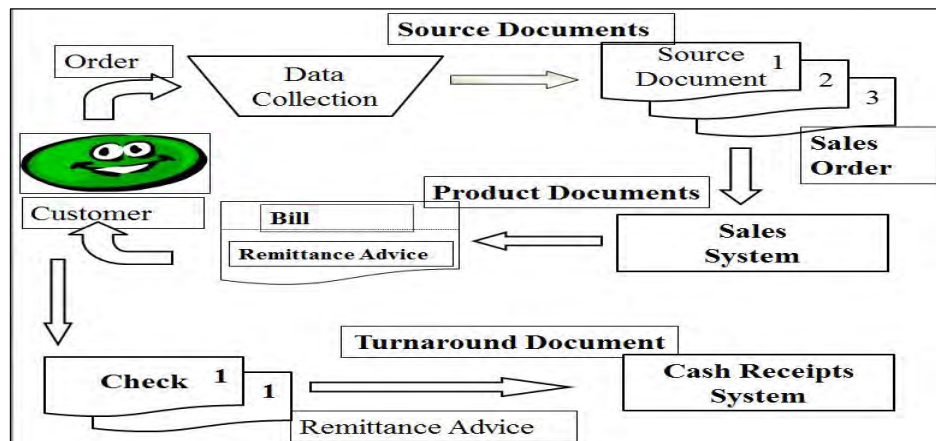


Fig. 1.7.1: System input documents for accounts BPM

- (iii) **Safeguard organisational assets:** Provide adequate controls to ensure that data are recorded and processed accurately by safeguarding organizational assets (data and systems). The two important methods for accomplishing this objective are by providing adequate documentation of all business activities and an effective segregation of duties. Documentation allows management to verify that assigned responsibilities were completed correctly. Segregation of duties refers to dividing responsibility for different portions of a transaction among several people. The functions to be performed by different people are authorizing (approval) transactions, recording (capture) transactions and maintaining custody (protect) of assets, thereby ensuring that business activities are performed efficiently and in accordance with management's objectives.

### 1.7.2 Processing Cycles of an Accounts BPM

**A. Processing Cycles of Accounts BPM:** These are namely **Financing Cycle, Revenue Cycle, Expenditure Cycle, Human Resource Cycle, and Production Cycle** and are identified in the Fig. 1.7.2.

- (i) **Financing Cycles:** A transaction processing cycle combines one or more types of transactions having related features or similar objectives. The cycle consists of a set of transactions leading to the recognition of a major economic event on the financial statements. It is through the study of transaction cycles that we gain a clear view of a firm's processing framework.
- (ii) **Revenue Cycle:** It includes transactions surrounding the recognition of revenue involving accounts like Sales, Accounts Receivable, Inventory and General Ledger. It involves capturing and recording of customer orders; shipment of the goods; and recording of the cost of goods sold; the billing process and the recording of sales and accounts receivable; and the capturing and recording of cash receipts.

Source Document	Function
Sales Order	Record Customer Order
Delivery Ticket	Record Delivery to Customer
Remittance Advice	Receive Cash
Deposit Slip	Record Amounts Deposited
Credit Memo	Support Adjustments to Customer Accounts

#### Revenue Cycle : Common Source Documents & Functions

- (iii) **Expenditure Cycle:** It includes transactions surrounding the recognition of expenditures involving accounts like Purchases, Accounts Payable, Cash Disbursements, Inventory and General Ledger. It includes preparation and recording of purchase orders; receipt of goods and the recording of the cost of inventory; receipt of vendor invoices; recording of accounts payable and preparation and recording of cash disbursements. The cycle also includes the preparation of employee paychecks and the recording of payroll activities.

Source Document	Function
Purchase Requisition	Request that purchasing department order goods.
Purchase Order	Request goods from vendors.
Receiving Report	Record receipt of merchandise.
Check	Pay for items.

#### Expéndice Cycle : Common Source Documents & Functions

- (iv) **Human Resource Cycle:** This involves activities of hiring and paying employees.

Source Document	Function
W4 forms	Collect employee withholding data.
Time cards	Record time worked by employees.
Job time tickets	Record time spent on specific jobs.

#### Human Resource Cycle: Common Source Documents & Functions

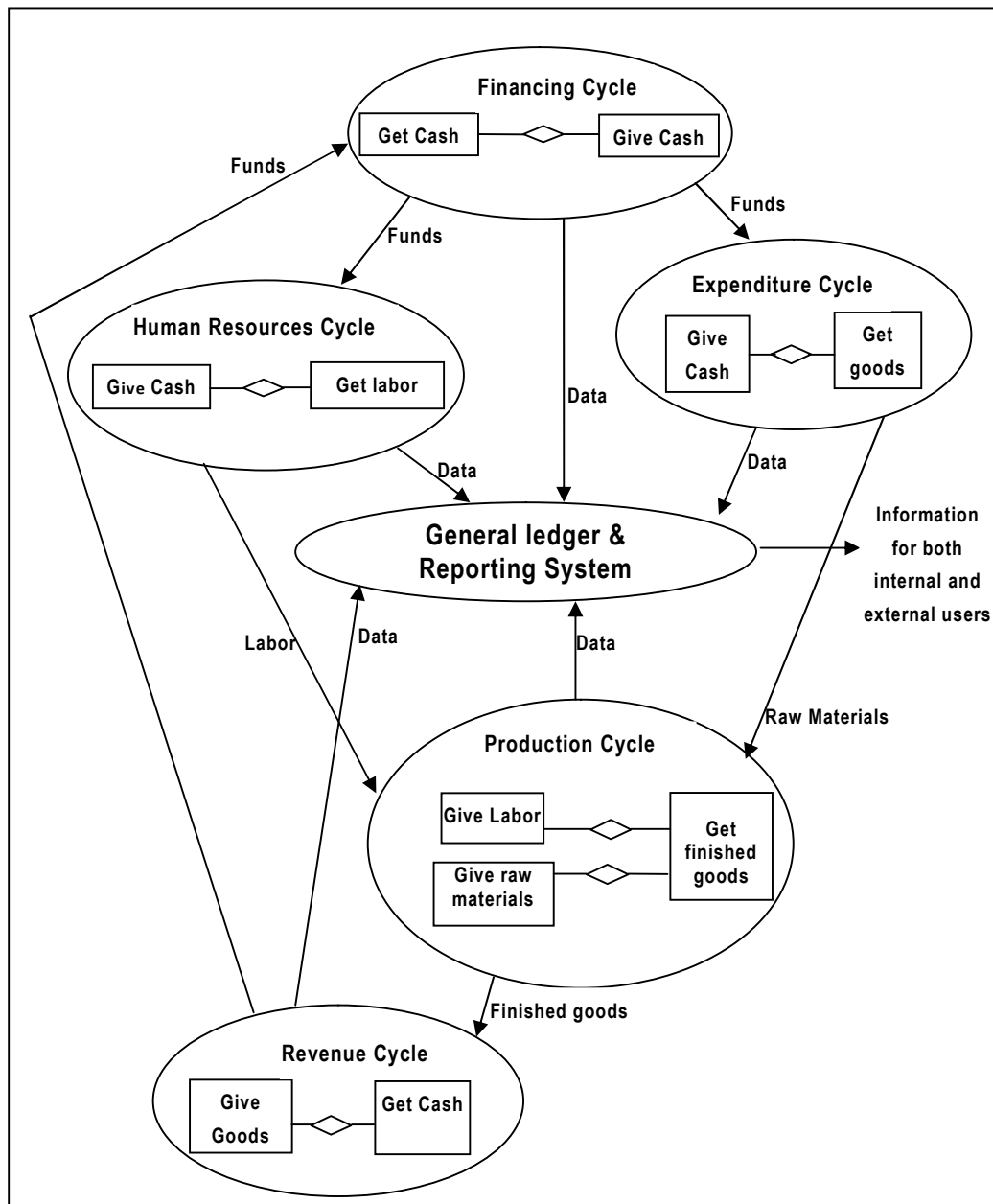
- (v) **Production Cycle:** This involves the recurring set of business activities and related data processing operations associated with the manufacturer of products including activities like converting raw materials and labor into finished goods.

**B. General Ledger & Reporting System:** The information processing operations involved in updating the general ledger and preparing reports, summarize the results of an organization's activities. An important function of the AIS is to efficiently and effectively collect and process the data about a company's transactions.

General Ledger and Reporting System	
Journal Voucher	Record entry posted to general ledger.

#### General Ledger & Reporting System - Common Source Documents & Functions

**C. Data Processing Cycle:** It may be noted, that all the above cycles of processing involves data processing activities which has been updated and stored. The stored information has details about the resources affected by the event and agents who participated in the activity. If the process of updating of the data stored is periodic, it is referred to as batch processing and if involves immediate updating as each transaction occurs, it is referred to as on-line, real-time processing. In the data processing cycle, the processes of business activities about which data must be collected and processed are identified. Further, the activities, resources affected by that event, the agents who participate in that event and the event of interest could be the input, output, processing, storage, alerts, controls and feedback.



**Fig. 1.7.2: Accounting Information Systems and its Subsystems**

The Data Processing Cycle consists of following basic steps with alerts, controls and feedback at each step:

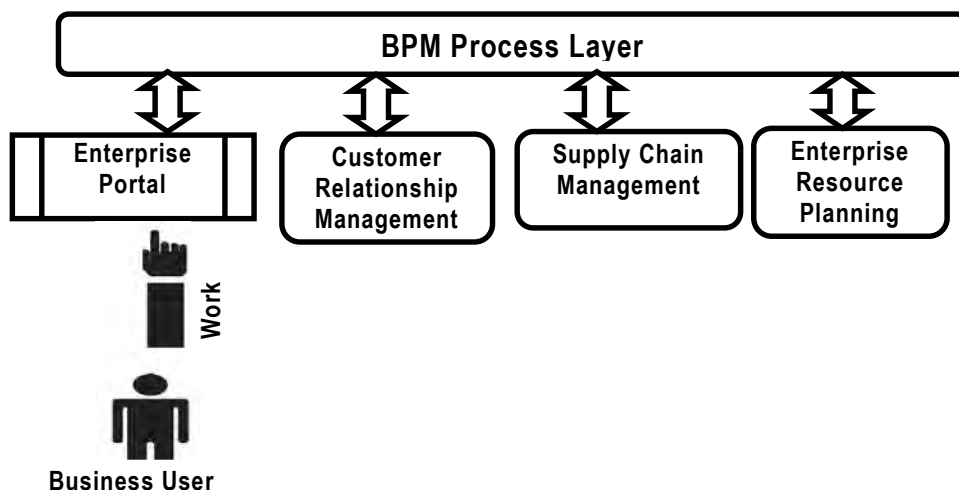
- **Data input** - Involves the activities like capturing the data, implementing control procedures, recording in journals, posting to ledgers and preparation of reports.

- **Data storage** - Involves organizing the data in master file or reference file of an automated system for easy and efficient access.
- **Data processing** - Involves addition, deletion and updating of the data in the transaction file, master file or reference file.
- **Information output** - Involves generation of documents and managerial reports in printable or electronic form for addressing queries, to control operational activities and help the management in decision making.

The controls on the data are maintained using Audit Trails. This is done by capturing snapshots or by tracing the flow of data. This provides a means to check the accuracy and validity of ledger postings. Storage of these data is in files named General Ledger, Accounts Payable ledger and Accounts Receivable ledger.

### 1.8 Impact of IT on BPM and Risks of failure of IT

BPM Systems or suites (BPMS) are a new class of software that allows enterprises to devise process centric IT solutions. 'Process-centric' means BPM solutions are able to integrate people, systems and data (see Fig. 1.8.1 given below).



**Fig. 1.8.1: Integration of People and Systems by BPM\***

Organizations that utilize BPM systems to accomplish IT enabled business process change, gain from the following capabilities:

- ♦ Closer business involvement in designing IT enabled business processes,
- ♦ Ability to integrate people and systems that participate in business processes,

\* "Business Process Management Systems, Strategy and Implementation", James. F Chang, Auerbach Publications, Page No. 52

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- ◆ Ability to simulate business processes to design the most optimal processes for implementation,
- ◆ Ability to monitor, control, and improve business processes in real time, and
- ◆ Ability to effect change on existing business processes in real time without an elaborate process conversion effort.

#### 1.8.1 Benefits of BPMS

BPMS, as a technology, can deliver endless benefits to any sized organization but more importantly these benefits are unique to a company:

- (a) **Automating repetitive business processes:** Processes such as report creation and distribution or the monitoring of or reporting on company's Key Performance Indicators (KPI) reduces the manual operational costs and helps employees to concentrate on activities that are important to the success of business.
- (b) **BPMS works by 'loosely coupling' with a company's existing applications:** This enables it to monitor, extract, format and distribute information to systems and people; in line with business events or rules.
- (c) **Operational Savings:** BPM focuses on optimization of processes. The processes that are repetitive are optimized and lead to reduced expenses which translate to immediate cost savings. By automating a task, ROI of BPM that requires six hours of manual intervention, one can expect to cut that time to half. Thus, three hours multiplied by the number of times the process is completed in a cycle will yield significant cost saving.
- (d) **Reduction in the administration involved in Compliance and ISO Activities:** Be it a quality assurance initiative such as the ISO standards, a financial audit law, or an IT systems best-practice implementation, companies worldwide are seeing the need to manage compliance as part of their everyday business activities. The BPM is ideally suited to help support companies in their quest for process improvement and compliance/governance certification. It gives full control over process and document change, clarity of inherent risks, and ease with which process knowledge is communicated across the company.
- (e) **Freeing-up of employee time:** While the euphuism "time is money" is often over-used, it is very relevant to this topic, because in business, for each additional hour it takes to complete a manual business process, there is a hard cost associated with employee time as well as soft costs associated with losing business or lowered productivity. Another area where time comes into play is in opportunity costs.

BPM or BPR software is a fast-growing segment of the enterprise software market, due to its support for re-engineering. Using BPM software tools, enterprises can document workflow and processes, to identify bottlenecks and other impediments to effectiveness, and recommend alternative and improved business processes. The purpose of BPM software is to update the documentation, analysis, monitor and re-design business processes in an enterprise.

### **1.8.2 Business Risks of failure of IT**

The numerous stumbling-blocks that organizations face with BPMS are primarily due to inadequate investment in ongoing training for involved personnel, as well as, lack of corporate policy protecting the integrity of the data in the BPM systems. Some of the other reasons for failure of BPMS include the following:

- ◆ Superficial or deficient executive involvement
- ◆ Deficient project management
- ◆ Breakdown in gap analysis
- ◆ Limited options for customization of the BPM software is required
- ◆ Not flexible enough or too complicated to be customized to meet the precise workflow and business process.
- ◆ Failure to identify future business needs
- ◆ Inadequate assessment of the need for change management
- ◆ Persistent compatibility problems with the diverse legacy systems of the partners.
- ◆ Resources not available when desirable
- ◆ Software fails to meet business needs
- ◆ System may be over-engineered when compared to the actual requirements.
- ◆ Technological obsolescence.

### **1.8.3 Information as a Business Asset**

For information to be used effectively - and therefore to maximize its strategic value - it must be available as a shared, easily accessible service within an organization by continuous updating the old database system. Information becomes an asset for an organization if it is useful, digital, accessible, relevant, accurate, trust-worthy, searchable, understandable, spatially enabled and shareable at the time when required. Information can be treated as a valuable commodity if it can be used effectively.

Information that is accurate and encompassing will allow decision-makers to better an organization's performance. Without reliable information, the decision-making process can be badly hampered and an informed decision impossible to make. Where a business is geographically dispersed, with servers hosted in different locations, or a business has a network of applications, there can also be the obstacle of replicating data across the network.

In short, without effectively management of information the result can be information chaos.

To achieve operational performance, it is important to ensure that Information Technology infrastructure is tailored to an organization that is able to meet an organization's needs for

Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Business Intelligence (BI), Data Warehousing, Data Migration and Replication.

### 1.9 Approaches to Mapping Systems

Accountants do not need to have the ability to program complex systems, but it is important for them to understand the documentation that describes how processing takes place. Documentation includes the flowcharts, narratives and other written communications that describe the inputs, processing and outputs of an Accounting Information System. Documentation also describes the logical flow of data within a computer system and the procedures that employees must follow to accomplish application tasks.

Some of the reasons why documentation is important to Information Systems are as follows:

- (a) **Depicting how the system works:** In computerized systems, the processing is electronic and invisible. Therefore documentation is required to help employees understand how a system works, assist accountants in designing controls for it, demonstrate to managers that it will meet their information needs, and assist auditors in understanding the systems that they test and evaluate.
- (b) **Training users:** Documentation also includes user guides, manuals, and similar operating instructions that help people learn how an Information System operates. These documentation aids help train users to operate Information systems hardware and software, solve operational problems, and perform their jobs better.
- (c) **Designing new systems:** Documentation helps system designers develop new systems in much the same way that blueprints help architects design building. Well-written documentation and related graphical systems-design methodologies play key roles in reducing system failures and decreasing the time spent correcting emergency errors.
- (d) **Controlling system development and maintenance costs:** Personal computer applications typically employ prewritten, off-the-shelf software that is relatively reliable and inexpensive. Good documentation helps system designers develop object-oriented software, which is software that contains modular, reusable code that further avoid writing duplicate programs and facilitate changes when programs must be modified later.
- (e) **Standardizing communications with others:** Documentation aids such as E-R Diagrams, System Flowcharts, and Data Flow Diagrams are more standardized tools, and they are more likely to be interpreted the same way by all parties viewing them. Thus, documentation tools are important because they help describe an existing or proposed system in a common language and help users communicate with one another about these systems.
- (f) **Auditing Information Systems:** Documentation helps depict audit trails. For example, when investigating an Accounting Information system, the auditors typically focus on internal controls. In such circumstances, documentation helps auditors determine the



strengths and weaknesses of a system's controls and therefore the scope and complexity of the audit.

- (g) **Documenting business processes:** Understanding business processes can lead to better systems and better decision. Documentation helps managers better understand how their businesses operate what controls are involved or missing from critical organizational activities, and how to improve core business activities.

Insufficient and deficient documentation costs organizations time and money and good documentation can be as important as the software it describes. Some of the popular pictorial representation or techniques which may be adopted for mapping business processes used are explained below. These are as follows:

1. Entity Relationship Diagram;
2. Data Flow Diagram;
3. Flowchart;
4. Decision Tree; and
5. Decision Table

### 1.9.1 Entity Relationship Diagram

An **Entity-Relationship (ER) diagram** is a data modeling technique that creates a graphical representation of the entities, and the relationships between entities, within an information system. ER diagrams repeatedly bring into play symbols to symbolize three dissimilar types of information.

- ◆ **Boxes** are commonly used to represent **entities**. An entity may be a 'physical object' such as a house or a car, an 'event' such as a house sale or a car service, or a 'concept' such as a customer transaction or order. The entity is represented by a rectangle and labeled with a singular noun.
- ◆ **Diamonds** are normally used to represent **relationships**. A relationship is an association that exists between two entities. For example, Instructor teaches Class or Student attends Class. Most relationships can also be stated inversely. For example, Class is taught by Instructor. The relationships on an ER Diagram are represented by lines drawn between the entities involved in the association.
- ◆ **Ovals** are used to represent **attributes**.

#### Types of Relationships

The various types of relationships have been shown in the Fig.1.9.1.

- (i) **One-to-One relationship (1:1)** - A One-to-One relationship is shown on the diagram by a line connecting the two entities.

**Example:** A Teacher may be in-charge of a class. Each class must be in-charge of by one teacher.



A student has one and only one Report card. Each report card is owned by one and only one student.

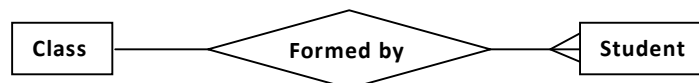


**(ii) One-to-Many relationship (1:N)** – A One-to-Many relationship is shown on the diagram by a line connecting the two entities with a “crow's foot” symbol denoting the 'many' end of the relationship.

**Example:** A student may borrow some books from the library. A book in the library may be borrowed by at most a student.



A class is formed by a group of atleast one student. Each student is allocated to one and only one class.



Further, a teacher teaches many courses.

**(iii) Many-to-One relationship (M:1)** – It is the reverse of One-to-Many relationship.

**Example:** As in two or more parent records to a single child record. For example,



When three administrators in a small town report to one minister.



**(iv) Many-to-Many relationships (M:N)** - A Many-to-Many relationship is shown on the diagram by a line connecting the two entities with 'crow's foot' symbols at both ends.

**Example:** A student enrolls in atleast one course. A course is enrolled by at least one student.



A student may apply for more than one scholarship. Each scholarship may receive some applications from student, or none.



#### Advantages of using E-R Diagram

- ER Modeling is simple and easily understandable. It is represented in business users' language and it can be understood by non-technical specialist.
- Intuitive and helps in Physical Database creation.
- Can be generalized and specialized based on needs.
- Can help in database design.
- Gives a higher level description of the system.

#### Limitations of using E-R Diagram

- Physical design derived from E-R Model may have some amount of ambiguities or inconsistency.
- Sometime diagrams may lead to misinterpretations.

**Example 1:** Construct an E-R diagram for a car-insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents.

**Solution:** Fig. 1.9.1 shows an example for Car Insurance Company. The underline represents the key elements.

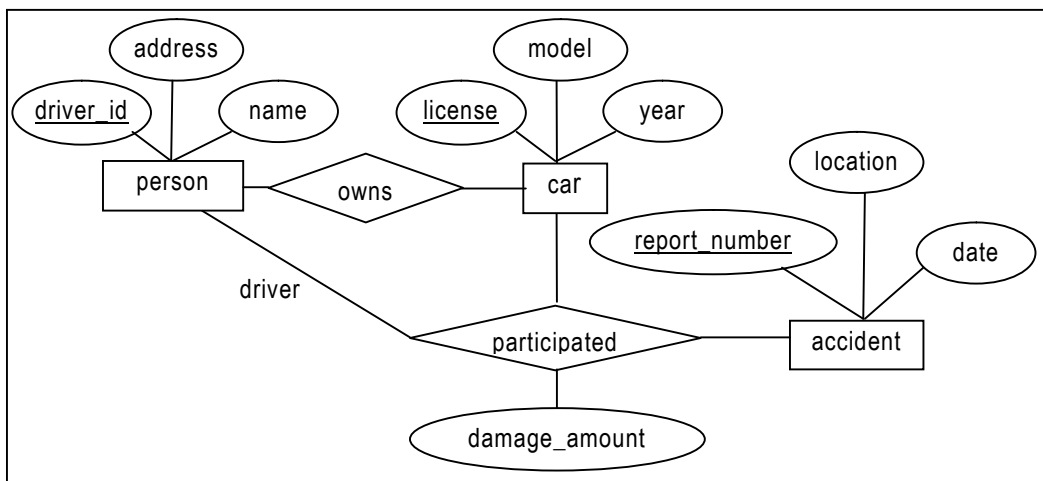


Fig. 1.9.1: E-R Diagram for Car Insurance Company


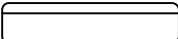

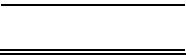
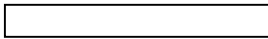
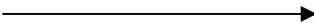
### 1.9.2 Data Flow Diagram

**Data Flow Diagram (DFD)** is a graphical representation of the flow of data through an information system. A DFD illustrates technical or business processes with the help of the external data stored, the data flowing from a process to another, and the results. DFDs may be partitioned into levels that represent increasing information flow and functional detail. Therefore, the DFD provides a mechanism for functional modeling as well as information flow modeling.

The four major DFD component's symbols are explained in the Table 1.9.1:

- (i) **Entity:** An entity is the source or destination of data. The source in a DFD represents these entities that are outside the context of the system. Entities either provide data to the system (referred to as a source) or receive data from it (referred to as a sink). Entities are often represented as rectangles (a diagonal line across the right-hand corner means that this entity is represented somewhere else in the DFD). Entities are also referred to as agents, terminators, or source/sink.
- (ii) **Process:** The process is the manipulation or work that transforms data, performing computations, making decisions (logic flow), or directing data flows based on business rules. In other words, a process receives input and generates some output. Process names (simple verbs and dataflow names, such as "Submit Payment" or "Get Invoice") usually describe the transformation, which can be performed by people or machines. Processes can be drawn as circles or a segmented rectangle on a DFD, and include a process name and process number.

**Table 1.9.1: Symbols used in DFD**

Meaning	Symbols
Process	 or 
Data Store	 or 
Entity	
Data Flow	

- (iii) **Data Store:** A data store is where a process stores data between processes for later retrieval by that same process or another one. Files and tables are considered data stores. Data store names (plural) are simple but meaningful, such as "customers", "orders" and "products." Data stores are usually drawn as a rectangle with the right hand side missing and labeled by the name of the data storage area it represents, though different notations do exist.
- (iv) **Data Flow:** Data flow is the movement of data between the entity, the process and the data store. Data flow portrays the interface between the components of the DFD. The

flow of data in a DFD is named to reflect the nature of the data used (these names should also be unique within a specific DFD). Data flow is represented by an arrow, where the arrow is annotated with the data name.

Any system in general is too complex to be shown on a single DFD. Decomposition is an iterative process of exploding DFDs to create more detail. Data Flow Diagrams can be expressed as a series of levels. We begin by making a list of business activities to determine the DFD elements (external entities, data flows, processes, and data stores). Context Diagram shows the interaction between the system and external agents.

The Context Diagram is a high-level DFD that shows the entire system as a single process and shows the interaction between the system and external agents which act as data sources and data sinks, and gives no clues as to its internal organization. The context-level DFD is next "exploded", to produce Level 1 DFDs for each process that show how the system is divided into sub-systems (processes), each of which deals with one or more of the data flows to or from an external agent, and which together provide all of the functionality of the system as a whole. There are two types of DFDs:

<b>Logical Data Flow Diagram</b>	A logical DFD focuses on the business and how the business operates. It describes the business events that take place and the data required and produced by each event. The logical model reflects the business.
<b>Physical Data Flow Diagram</b>	A physical DFD shows how the system will be implemented. The physical model depicts the system.

#### **Advantages of using Data Flow Diagram**

- It aids in describing the boundaries of the system.
- It is beneficial for communicating existing system knowledge to the users.
- A straightforward graphical technique which is easy to recognize.
- DFDs can provide a detailed representation of system components.
- It is used as the part of system documentation file.
- DFDs are easier to understand by technical and nontechnical audiences
- It supports the logic behind the data flow within the system.

#### **Limitations of using Data Flow Diagram**

- It make the programmers little confusing concerning the system.
- The biggest drawback of the DFD is that it simply takes a long time to create, so long that the analyst may not receive support from management to complete it.
- Physical considerations are left out.

**Example 2:** Draw a Context Diagram for a Bank System that interacts with the following five agents: Customers, Bank Managers, Third Parties, Sales agents and Other Banks.

**Solution:** The Context Diagram is shown in the Fig. 1.9.2. This diagram shows the entirety of our proposed **Bank System** encapsulated as a single process that sends data to and receives data from various external interfaces.

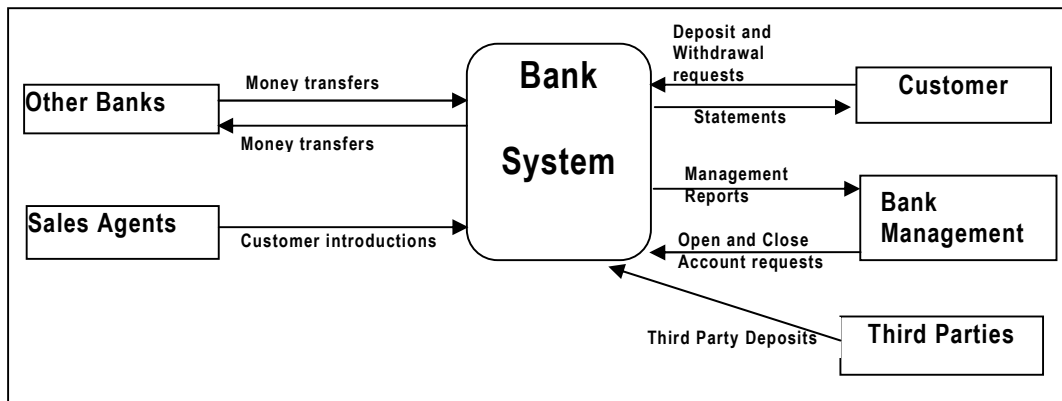
The interfaces to the right represent human actors.

- (a) **Customers** can send **Deposit and Withdrawal requests** to our system and can receive **statements** from it.
- (b) **Bank Managers** can send **Open and Close Account Requests** to the system and can receive **Management reports** from it.
- (c) **Third Parties** can send **third party deposits** to the system, but obviously not make withdrawal requests.

The interfaces to the left represent system actors.

- (d) The first interface on the left represents the **Other Banks** which may send or receive **Money Transfers** when interacting with our system. These other banks are likely to be system actors (i.e. computer programs) rather than human actors.
- (e) The second interface on the left represents the **Sales Agents**, which are external affiliate companies or individuals who generate **Customer Introductions** for our system.

While the Context Diagram shows the kind of data that is exchanged between the system and the external interfaces, it implies nothing at all regarding the sequence in which those data exchanges take place.



**Fig. 1.9.2: Context Diagram of a Bank System**

### 1.9.3 Flowchart

A **Flowchart** is a type of diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. Flowcharts are used in analyzing, designing, documenting or managing process or program in various fields. It is like a blueprint, in that it shows the general plan, architecture, and essential details of the proposed structure. It is an essential tool for programming and it illustrates the strategy and thread of logic followed in the program. It allows the programmer to compare different approaches and alternatives on paper and often shows interrelationships that are not immediately apparent. A flowchart helps the programmer avoid fuzzy thinking and accidental omissions of intermediate steps. Fig. 1.9.3 details all the flowcharting symbols:

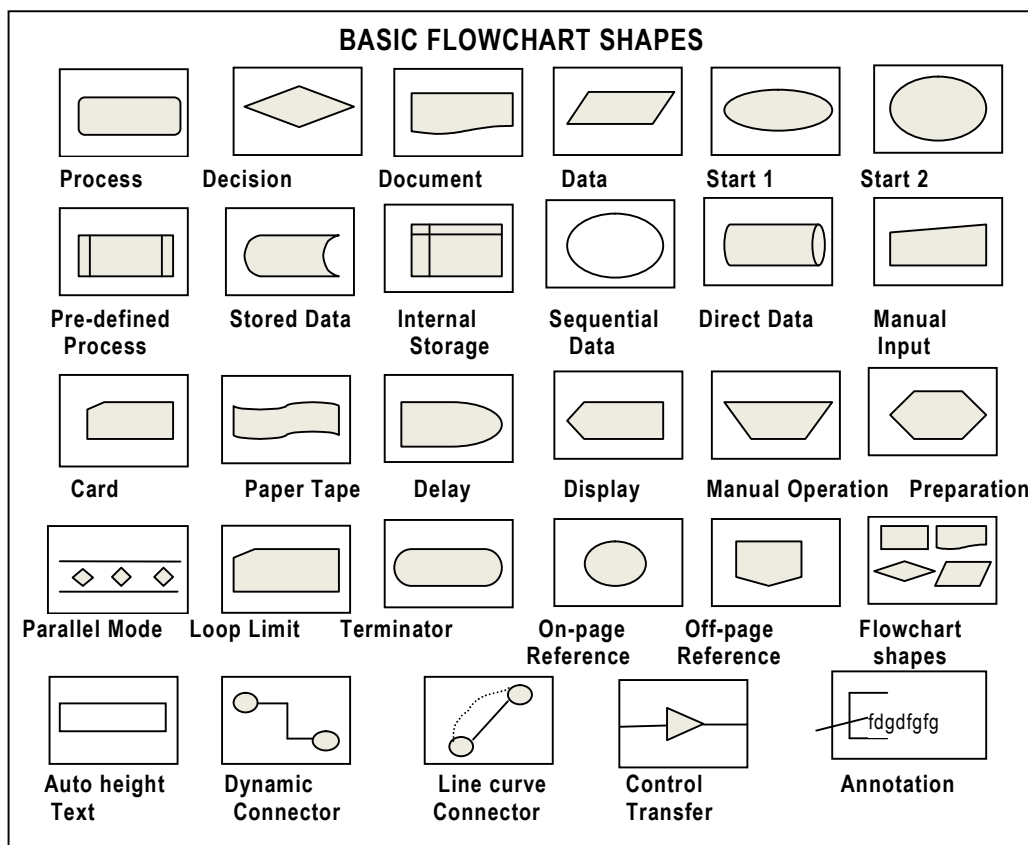


Fig. 1.9.3: Standard Flowchart Symbols

However, many classification of Flowchart exists; broadly, they are categorized as below in Table 1.9.2:

**Table 1.9.2: Flowchart Types**

Type of Flowchart	Explanation
<b>Document Flowchart</b>	This flowchart traces the physical flow of documents through an organization – that is, the flow of documents from the departments, groups, or individuals who first created them to their final destinations.
<b>System Flowchart</b>	This typically depicts the electronic flow of data and processing steps in an Information System. While Document Flowcharts focus on tangible documents, system flowchart concentrates on the computerized data flows of Information systems.
<b>Program Flowchart</b>	It is most detailed and is concerned with the logical/arithmetic operations on data within the CPU and the flow of data between the CPU on the one hand and the input/output peripherals on the other.

**Advantages of using Flowchart**

- (i) **Quicker grasp of relationships** – Before any application can be solved, it must be understood, the relationship between various elements of the application must be identified. The programmer can chart a lengthy procedure more easily with the help of a flowchart than by describing it by means of written notes.
- (ii) **Effective Analysis** – The flowchart becomes a blue print of a system that can be broken down into detailed parts for study. Problems may be identified and new approaches may be suggested by flowcharts.
- (iii) **Communication** – Flowcharts aid in communicating the facts of a business problem to those whose skills are needed for arriving at the solution.
- (iv) **Documentation** – Flowcharts serve as a good documentation which aid greatly in future program conversions. In the event of staff changes, they serve as training function by helping new employees in understanding the existing programs.
- (v) **Efficient coding** – Flowcharts act as a guide during the system analysis and program preparation phase. Instructions coded in a programming language may be checked against the flowchart to ensure that no steps are omitted.
- (vi) **Orderly check out of problem** – Flowcharts serve as an important tool during program debugging. They help in detecting, locating and removing mistakes.
- (vii) **Efficient program maintenance** – The maintenance of operating programs is facilitated by flowcharts. The charts help the programmer to concentrate attention on that part of the information flow which is to be modified.



### Limitations of using Flowchart

- (i) **Complex logic** – Flowchart becomes complex and clumsy where the problem logic is complex. The essentials of what is done can easily be lost in the technical details of how it is done.
- (ii) **Modification** – If modifications to a flowchart are required, it may require complete re-drawing.
- (iii) **Reproduction** – Reproduction of flowcharts is often a problem because the symbols used in flowcharts cannot be typed.
- (iv) **Link between conditions and actions** – Sometimes it becomes difficult to establish the linkage between various conditions and the actions to be taken there upon for a particular condition.
- (v) **Standardization** – Program flowcharts, although easy to follow, are not such a natural way of expressing procedures as writing in English, nor are they easily translated into Programming language.

**Example 3:** Draw the Program Flowchart for finding the sum of first 100 odd numbers.

**Solution:** The flowchart is drawn as Fig. 1.9.4 and is explained step by step below. The step numbers are shown in the flowchart in circles and as such are not a part of the flowchart but only a referencing device.

Our purpose is to find the sum of the series 1, 3, 5, 7, 9.....(100 terms.) The student can verify that the 100th term would be 199. We propose to set  $A = 1$  and then go on incrementing it by 2 so that it holds the various terms of the series in turn. B is an accumulator in the sense that A is added to B whenever A is incremented. Thus B will hold:

1

$1 + 3 = 4$

$4 + 5 = 9,$

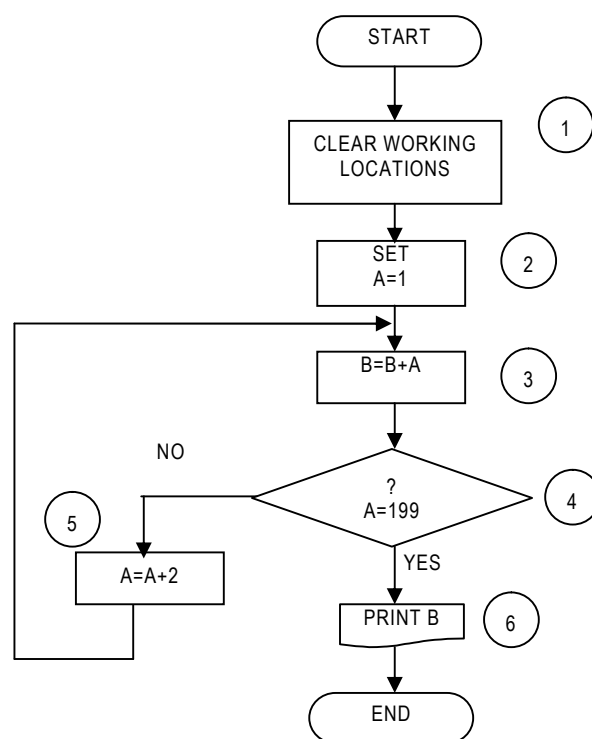
$9 + 7 = 16,$  etc. in turn.

**Step 1** - All working locations are set at zero. This is necessary because if they are holding some data of the previous program, that data is liable to corrupt the result of the flowchart.

**Step 2** - A is set at 1 so that subsequently by incrementing it successively by 2, we get the wanted odd terms: 1,3,5,7 etc.

**Step 3** - A is poured into B i.e., added to B. B being 0 at the moment and A being 1, B becomes  $0 + 1 = 1$ .

**Step 4** - Step 4 poses a question. "Has A become 199 ?" if not, go to step 5, we shall increment A by 2. So that although at the moment A is 1, it will be made 3 in step 5, and so on. Then go back to step 3 by forming loop.



**Fig. 1.9.4: Flowchart for addition of first 100 odd numbers**

Since we have to stop at the 100<sup>th</sup> terms which is equal to 199, Thus, A is repeatedly incremented in step 5 and added to B in step 3. In other words, B holds the cumulative sum up to the latest terms held in A.

When A has become 199 that means the necessary computations have been carried out so that in step 6 the result is printed.

**Table 1.9.3: Differences between Flowchart and Data Flow Diagram**

Flowchart	Data Flow Diagram
Flow chart presents steps to complete a process.	DFD presents the flow of data.
Flow chart does not have any input from or output to an external source.	DFD describes the path of data from an external source to internal source or vice versa.
The timing and sequence of the process is aptly shown by a flowchart.	Whether processing of data is taking place in a particular order or several processes are taking place simultaneously is described by a DFD.

Flow chart shows how to make a system function.	DFD define the functionality of a system.
Flow chart is used in designing a process.	DFD is used to describe the path of data that will complete that process.
Types of Flow charts – System, Data, Document and Program.	Types of DFD – Physical Data Flow and Logical Data Flow.

Table 1.9.3 list major differences between Flowchart and Data Flow Diagram.

### 1.9.4 Decision Tree

A **Decision Tree** also termed as an **Inference** or **Logical tree** is a collection of a basis (condition) and a conclusion (action). In its tree-like representation, the premises and conclusions are shown as nodes, and the branches of the tree connect the premises and the conclusions. The logical operators “AND” and “OR” are used to replicate the structure of the if-then rules. As such, decision tables (DTs) do not seem to differ much from a decision tree.

A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. It is one way to display an algorithm. Decision trees are commonly used in operations research, specifically in decision analysis, to help identify a strategy most likely to reach a goal.

Instead of specifying a table, the preference maker constructs a graph of the decision alternatives emanating as branches from a root node over a number leafs. A decision is the assortment between achievable actions. A choice is the range between two or more objects. Decision Trees are measured to be one of the most accepted approaches for representing classifier. Researchers from a variety of disciplines such as statistics, machine learning, pattern identification and data mining have dealt with the issue of growing a decision tree from available data. Decision trees are a simple, but powerful form of multiple variable analyses.

They provide unique capabilities to supplement, complement, and substitute for-

- ◆ traditional statistical forms of analysis (such as multiple linear regression)
- ◆ a variety of data mining tools and techniques (such as neural networks)
- ◆ recently developed multidimensional forms of reporting and analysis found in the field of business intelligence

#### Advantages of using Decision Tree

- Are simple to understand and interpret. People are able to understand decision tree models after a brief explanation.
- Possible scenarios can be added.
- Worst, best and expected values can be determined for different scenarios.

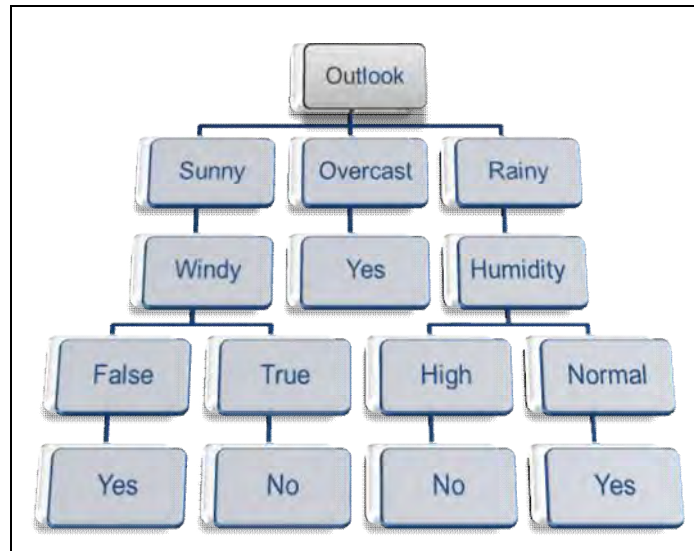
**Limitations of using Decision Tree**

- For data including categorical variables with different number of levels, information gain in decision trees are biased in favor of those attributes with more levels.
- Calculations can get very complex particularly if many values are uncertain and/or if many outcomes are linked.

**Example 5:** Draw a Decision Tree for the below mentioned problem.

PREDICTORS				TARGET
Outlook	Temperature	Humidity	Windy	Play Golf
Rainy	Hot	High	False	No
Rainy	Hot	High	True	No
Overcast	Hot	High	False	Yes
Sunny	Mild	High	False	Yes
Sunny	Cool	Normal	False	Yes
Sunny	Cool	Normal	True	No
Overcast	Cool	Normal	True	Yes
Rainy	Mild	High	False	No
Rainy	Cool	Normal	False	Yes
Sunny	Mild	Normal	False	Yes
Rainy	Mild	Normal	True	Yes
Overcast	Mild	High	True	Yes
Overcast	Hot	Normal	False	Yes
Sunny	Mild	High	True	No

**Solution:** Decision tree builds categorization or regression models in the shape of a tree structure. It breaks down a dataset into slighter and slighter subsets while at the same time an allied decision tree is incrementally developed. The concluding consequence is a tree with decision nodes and leaf nodes.



**Fig. 1.9.5: Decision Tree Conceptual View**

As shown in Fig. 1.9.5, the decision node (e.g., Outlook) has two or more branches (e.g., Sunny, Overcast and Rainy). Leaf node (e.g., Play) represents a categorization or decision. The uppermost decision node in a tree which corresponds to the greatest predictor called root node. Decision trees can grip both clear-cut and numerical data.

### 1.9.5 Decision Table

A **Decision Table** is a table which may accompany a flowchart, defining the possible contingencies that may be considered within the program and the appropriate course of action for each contingency. A Decision Table is divided into four parts:

- Condition Stub** - which comprehensively lists the comparisons or conditions;
- Action Stub**- which comprehensively lists the actions to be taken along the various program branches;
- Condition Entries** - which list in its various columns the possible permutations of answer to the questions in the conditions stub; and
- Action Entries** - which lists, in its columns corresponding to the condition entries the actions contingent upon the set of answers to questions of that column.

A Decision Table is divided into four quadrants:

Condition Stub	Condition Entries
Action stub	Action Entries

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A Decision Table is given below as an example:

		Granting Credit Facility	R1	R2	R3	
Part 1	C1	Credit limit Okay	Y	N	N	Part 3
	C2	Pay experience Favorable	-	Y	N	
Part 2	A1	Allow Credit Facility	X	X		Part 4
	A2	Reject Order			X	

There are two conditions: C1 and C2 in this table and two actions: A1 and A2. According to R1 (a set of rules), if there is a “Yes” to C1 and C2 is to be bypassed, action A1 will be taken, that is, “Allow credit facility”. Under R3, No’s to both C1 and C2 requires action A2 to be taken. With this example, we give below the components of the decision table in more detail.

- (a) **Condition Statement** - Statement which introduce one or more conditions (*i.e.*, factors to consider in making a decision)
- (b) **Condition Entries** - Entries that complete condition statements.
- (c) **Action Statements** - Statements which introduce one or more actions (*i.e.*, steps to be taken when a certain combination of conditions exist)
- (d) **Action Entries** - Entries that complete the action statements.
- (e) **Rules** - Unique combinations of conditions and actions to be taken under those conditions.
- (f) **Header** - Title identifying the table.
- (g) **Rule Identifiers** - Code (R1, R2, R3,) uniquely identifying each rule within a table.
- (h) **Condition Identifiers** - Codes (C1, C2, C3...) uniquely identifying each condition statements/entry.
- (i) **Action Identifiers** - Codes (A1, A2, & A3...) uniquely identifying each action statement/entry

These items are contained within the body of the table which is divided into four major sections by double or heavy vertical and horizontal lines as in the table above.

### Steps in Preparing a Limited Entry Decision Table

- List conditions and actions.
- Combine conditions which describe the only two possibilities of a single condition. In other words, delete conditions which can be derived from the responses of the other conditions.
- Make yes or no (Y or N) responses and mark actions to be taken for each rule with X.
- Combine redundant rules to simplify table.
- Check for completeness.

An example will be used to explain and illustrate the procedure.

**Example 6:** Select the largest of three distinct numbers A,B,C

**Solution:** Step 1 - Conditions involved in the problem is as follows:

1. A > B
2. A > C
3. B > A
4. B > C
5. C > A
6. C > B

Actions involved in the problem are as follows:

1. A is largest
2. B is largest
3. C is largest

Step 2 - Conditions 1 & 3 can be combined; Conditions 2 & 5 can be combined and  
Conditions 4 & 6 can be combined

Therefore, there are only three conditions:

1. A > B
2. A > C
3. B > C

Step 3 - No. of rules =  $2^{\text{nd}} \text{ conditions} = 2^3 = 8$

	Select Largest	R1	R2	R3	R4	R5	R6	R7	R8
C1	A > B	Y	Y	Y	Y	N	N	N	N
C2	A > C	Y	Y	N	N	Y	Y	N	N
C3	B > C	Y	N	Y	N	Y	N	Y	N
A1	A is largest	X	X						
A2	B is largest					X		X	
A3	C is largest				X				X

\*R3 and R6 contain impossible combination of condition entries.

Step 4 - R1 & R2 can be combined

R3 & R4 can be combined

R5 & R7 can be combined

R6 & R8 can be combined

	Select largest	R1	R2	R3	R4
C1	A > B	Y	Y	N	N
C2	A > C	Y	N	—	—
C3	B > C	—	—	Y	N
A1	A is largest	X			
A2	B is largest			X	
A3	C is largest		X		X

*Step 5* - All the rules in the reduced table have one dash. Therefore, the sum of the rules represented by rules in the reduced table is  $2^1 + 2^1 + 2^1 + 2^1$  which is equal to  $2^3$  or 8. No. of conditions is 3 and hence the No. of rules to be accounted for is  $2^3$  or, 8. Therefore the reduced table is complete.

If problem has many conditions, the decision table may become quite large and difficult to follow. Since the objective of the table is to show the logic of the procedure as clearly and as simply as possible, a large, complex table should be avoided. In most cases, a large problem with many conditions can be subdivided into two or more tables. One or more of the actions of the first table will specify that the user should proceed to another table to complete the logic. An example is given to illustrate this use of more than one table.

### Advantages of using Decision Table

- (i) **Easy to Draw** – Decision Tables are easy to draw and modify as compared to flowcharts.
- (ii) **Compact Documentation** – The documentation in the form of decision tables is compact since one decision table may replace few pages of a flowchart.
- (iii) **Simplicity** – It is easier to follow a particular path in one column of a decision table than it is to go through several pages of the flowcharts.
- (iv) **Direct Codification** - The decision tables can be directly coded into a program.
- (v) **Better Analysis** – A decision table shows various alternatives and their respective outcomes side by side for better analysis of the problem.
- (vi) **Modularity** – The complex problems would require complex decision tables which can be easily broken down to micro-decision tables.
- (vii) **Non-technical** – No knowledge of computer language or CPU working is necessary for drawing decision tables.

### Limitations of using Decision Table

- (i) All programmers may not be familiar with Decision Tables and therefore flow charts are more common
- (ii) Flowcharts can better represent a simple logic of the system rather than a decision table.



- (iii) The decision tables do not express the total sequence of the events needed to solve the problem.

**Example 7:** A technical support company writes a decision table to diagnose printer problems based upon symptoms described to them over the phone from their clients.

**Solution:** The decision Table is shown in the Table 1.9.4.

**Table 1.9.4: Printer troubleshooter**

		Rules							
<b>Conditions</b>	Printer does not print	Y	Y	Y	Y	N	N	N	N
	A red light is flashing	Y	Y	N	N	Y	Y	N	N
	Printer is unrecognized	Y	N	Y	N	Y	N	Y	N
<b>Actions</b>	Check the power cable			X					
	Check the printer-computer cable	X		X					
	Ensure printer software is installed	X		X		X		X	
	Check/replace ink	X	X			X	X		
	Check for paper jam		X		X				

## 1.10 Summary

"Process thinking" is the new approach to solving business problems. In this chapter we have learned how viewing an organization as a system of set of interlinked processes rather than functional silos could bring about significant improvements in the overall performance of the business and help in achievement of organizational objectives. Businesses are a collection of connected processes and that to be agile, those processes must frequently be realigned or reconnected so they can address changing business environments, redefined business objectives and newly imposed regulations.

Business Process Management (BPM) is a holistic approach for aligning business processes with the needs of the customers. The idea is to view processes as assets that provide value to customers. Hence a systematic approach to continuously improve the business processes through innovation, integration and use of technology is essential to ensure survival of the business as well as improvement in business effectiveness and efficiency.

BPM systems allow organizations to devise process centric information technology solutions. Process-centric means BPM solutions are able to integrate people, systems, and data. BPM solutions enable business users, analysts, managers and other stakeholders to collaborate with developers in implementation process through the - Business Process Management

Lifecycle. Different levels can be identified in business process management, ranging from high-level business strategies to implemented business processes.

BPM can be applied in many disparate ways, depending on the sector in which it is being used. Several approaches to mapping business processes may be adopted including entity relationship diagrams, data flow diagrams, systems flow diagrams, system outline charts, decision trees, decision tables, etc. The purpose of mapping is to define clearly the activities involved in a business process and to find opportunities for improvements in the current process.

Business Process Reengineering (BPR) aims at major transformation in business processes to achieve dramatic improvements. Here, the business objectives of the enterprise are achieved by “transformation” of business processes which may, or may not, require the use of Information Technology (IT).

The Payback achieved by industries through implementing BPM need be quantitatively assessed to identify the areas of improvement. The numerous stumbling-blocks that organizations face with BPM systems are due to inadequate investment in ongoing training for involved personnel, including those implementing and testing changes, as well as a lack of corporate policy protecting the integrity of the data in the BPM systems and the way it is used.